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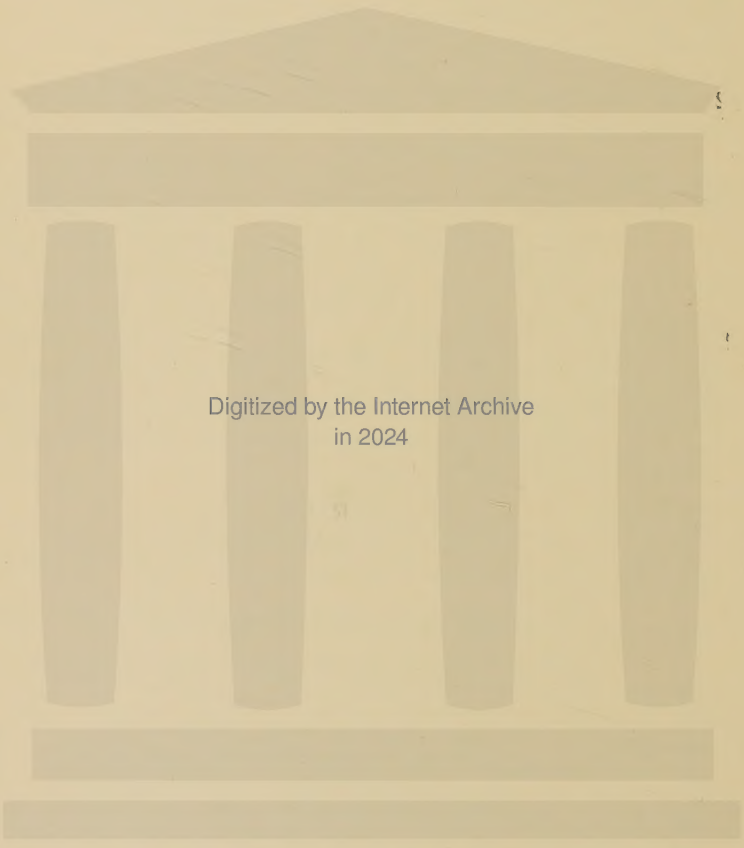
ERRATA.

Page 10 line 10 for " *B.* (*C.*) *victoriae* " read " *B.* (*C.*) *victoria* "
,, 10 line 29 for " Encyrtid " read " Eulophid "
,, 24 line 21 for " vetch day " read " vetch hay "
,, 33 line 18 for " *M. simplex* " read " *A. simplex* "
,, 54 line 18 for " *Echnocnemus* " read " *Echinocnemus* "
,, 65 6 lines from end for " Say " read " Curt."
,, 88 7 lines from end for " *Crytopeltis* " read " *Cyrtopeltis* "
,, 109 5 lines from end for " Trapped " read " Tapped "
,, 125 line 13 for " Chorosol " read " Chlorosol "
,, 144 13 lines from end for " Colombia " read " Columbia "
,, 145 8 lines from end for " 1934 " read " 1924 "
,, 159 line 6 for " [17·6–73·4°F.] " read " [71·6–73·4°F.] "
,, 172 4 lines from end for " *Orgya* " read " *Orgyia* "
,, 203 line 22 for " no. 15 " read " no. 152 "
,, 212 20 lines from end for " Granada " read " Grenada "
,, 223 lines 19 and 18 from end for " paradichlorobenzine " read " paradichlorobenzene "
,, 231 9 lines from end for " *Isostarius* " read " *Isostasius* "
,, 233 lines 11 and 12 for " 3 examples of which were reared from a single host in June, and the Eulophid " read " 3 examples of which were reared, and the Eulophid "
,, 237 10 lines from end for " (*Myzides*) " read " (*Myzoides*) "
,, 238 lines 18 and 6 from end for " *Bromus* " read " *Brumus* "
,, 270 line 10 for " (*Brachyrhinus*) " read " (*Brachyrrhinus*) "
,, 289 22 lines from end for " [**26** 30] " read " [**26** 31] "
,, 293 line 8 for " [*R.A.E.*, A **25** 901] " read " [*R.A.E.*, A **25** 801] "
,, 315 lines 12 and 13 for " *seabri* " read " *seabrai* "
,, 328 4 lines from end for " *Erythelmus* " read " *Erythmelus* "
,, 337 line 16 for " *frogatti* " read " *froggatti* "
,, 340 line 10 for " *Astychus* " read " *Astycus* "
,, 342 line 16 for " *succinta* " read " *succincta* "
,, 350 line 2 for " *chittendi* " read " *chittendeni* "
,, 351 3 lines from end for " 30–100 per cent." read " 80–100 per cent."
,, 383 3 lines from end for " *O. rugostriatus* " read " *O. rugosostriatus* "
,, 390 line 15 for " carbon dioxide " read " carbon bisulphide "
,, 399 line 4 for " *Corythucha* " read " *Corythuca* "
,, 416 line 8 for " FRAPPA (M. C.) " read " FRAPPA (M.) "
,, 433 6 lines from end for " *Crotolaria* " read " *Crotalaria* "
,, 452 line 6 for " *Rhyncophorus* " read " *Rhynchophorus* "
,, 457 13 lines from end for " *Rhozopus* " read " *Rhizopus* "
,, 498 line 11 for " [*cf. R.A.E.*, A **25** 638] " read " [*cf. R.A.E.*, A **25** 738] "
,, 528 line 8 for " *C. rubripennis* " read " *C. rubiginosa* "
,, 592 lines 21 and 22 for " *P. citri*, Risso (*lilacinus*, Ckll.) " read " *P. lilacinus*, Ckll."
,, 597 line 1 for " FEYTAUD (J.) " read " FEYTAUD (J.), BRUNETEAU (J.) & DUPOUX (R.) "
,, 628 13 lines from end for " *Pennisetium* " read " *Pennisetum* "
,, 673 line 17 for " *sininsis* " read " *sinensis* "
,, 688 16 lines from end for " *Telonomus* " read " *Telenomus* "
,, 690 line 6 for " *Althea* " read " *Althaea* "
,, 715 10 lines from end for " [*cf. R.A.E.*, A **16** 665] " read " [*cf. R.A.E.*, A **26** 665] "
,, 752 line 10 for " (*Cordiaeum* sp.) " read " (*Codiaeum* sp.) "
,, 765 8 lines from end for " *Raphidopalpa* " read " *Rhaphidopalpa* "



IMPERIAL INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES A.

VOL. 26. 1938.

THORPE (W. H.) & JONES (F. G. W.). **Olfactory Conditioning in a parasitic Insect and its Relation to the Problem of Host Selection.** —*Proc. roy. Soc.* (B) **124** no. 834 pp. 56–81, 1 fig., 14 refs. London, September 1937.

The following is substantially the authors' summary: This paper describes experiments with the endoparasitic Ichneumonid, *Nemeritis canescens*, Grav., the normal host of which is the larva of *Ephestia kuehniella*, Zell. Since *Nemeritis* is a parasite that finds its host almost entirely by the sense of smell, which resides in the antennae, it was considered peculiarly suited to an investigation of the effect of the larval environment on the oviposition responses of the adult. The importance of the subject lies in its relation to the so-called " Hopkins Host-Selection Principle " [*cf. R.A.E.*, A **10** 83] and its bearing on the problem of the origin of biological races in insects and other animals. Although the genus *Ephestia* provides the only known hosts of this parasite in Europe, there exists in the United States a race that attacks the large wax moth, *Galleria mellonella*, L.

It was found that, although it is extremely difficult to rear the European race of *Nemeritis* on *Galleria*, there is no great obstacle to securing oviposition in the larvae of the small wax moth, *Achroia* (*Meliphora*) *grisella*, F., provided that they are first placed in close contact with *Ephestia* larvae so as to be thoroughly contaminated with the smell of that host. Once the eggs are inserted in the body cavity of *Achroia* they develop normally, and the larvae develop and adults are produced without any great mortality. No apparent changes in structure or colour result. The olfactory responses of *Nemeritis* reared in this way were compared with those of insects reared on the normal host by means of a McIndoo olfactometer of an improved type.

The experiments indicate that there is a strong germinally fixed tendency to follow up the odour of *Ephestia*. Insects that have been reared on *Ephestia* show no reaction whatever to the smell of *Achroia*, but those reared from *Achroia*, while still preferring *Ephestia*, show a significant attraction to *Achroia*, such that, when given the alternative of the two hosts in the olfactometer, the proportion choosing *Ephestia* is reduced from 85 to 65·8 per cent.

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It is shown that some change in the olfactory responses may be brought about merely by exposing *Nemeritis* to contact with *Achroia* larvae for a period immediately on emergence from the pupa. Further experiments indicate, however, that the whole of the effect of rearing on *Achroia* is not due to this, but that at least some conditioning effect results from the influence of the host acting during the pre-imaginal period.

The odour of oatmeal, one of the usual food substances of *Ephestia*, also exerts a slight attraction upon *Nemeritis*. There is no evidence that continued rearing on the abnormal host over a number of generations increases the response to that host. It is concluded that *Nemeritis* has an inherited oviposition response to *Ephestia* larvae, but that an additional oviposition response to the odour of *Achroia*, a response that is entirely lacking in the normal insect, can be induced by contact with the new host. While this does not produce any diminution in the ability of the insect to respond to *Ephestia* when no other attraction is present, it does result in a significant reduction of the proportion which go to *Ephestia* when the two alternatives are equally available. The application of these results to the problem of the origin of new races is discussed.

JANCKE (O.). **Ueber die Blutlausanfälligkeit von Apfelsorten, wilden Malusarten und -bastarden, sowie die Züchtung blutlausfester Edeläpfel und Unterlagen.** [On the Susceptibility to Infestation by the Woolly Aphis of various Apples, wild Apples and their Hybrids, and on the Breeding of immune edible Apples and Stocks.]—*Phytopath. Z.* **10** no. 2 pp. 184–196 1 fig., 8 refs. Berlin, 1937.

This paper gives the results of experiments carried out for several years at Naumburg on the differences in liability to infestation by the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] of 103 varieties of edible apples and 79 wild apples and hybrids. Lists show the average and maximum liability to infestation of the varieties in 5 categories, ranging from great susceptibility to complete immunity. The findings agreed in part with those published by earlier investigators. Variations in the resistance of a given variety are believed to be due not only to locality, but also to the as yet unexplained influence of stocks on grafted edible apples. Of the varieties of edible apples, only 6 were completely immune, but 50 were practically so. Of the wild apples and hybrids, 17 per cent. were immune and 64 per cent. practically so. Crossings between immune or practically immune edible apples produced seedlings of which 64 per cent. were immune and 23 per cent. practically so. Crossings between wild apples that were practically immune gave seedlings of which 78 per cent. were immune and 18 per cent. practically so. As the Aphid can survive severe winters on the stocks, the breeding of immune stocks is important.

FRANCKE-GROSMANN (H.). **Oekologie und Schadwirkung von *Dreyfusia prelli* Grosmann.** [Ecology and injurious Action of *Chermes prelli*, Grosmann.]—*Z. PflKrankh.* **47** no. 10 pp. 497–516, 8 figs., 17 refs. Stuttgart, 1937.

This is a more detailed account of the bionomics and ecology of *Chermes* (*Dreyfusia*) *prelli*, Grosmann, at Pillnitz, Saxony [*cf. R.A.E.*, A **24** 267; **25** 763], and its life-history is compared with that of

C. (*D.*) *nordmannianae*, Eckstein. Both species alternate between oriental spruce (*Picea orientalis*) and silver fir, which for *C. prelli* is usually *Abies nordmanniana* and, more rarely, *A. cephalonica*. On silver fir, the sistentes settle on the bark of young branches and shoots, and the sexuparae develop on young, soft parts of the plant, but whereas some of the sistentes of *C. nordmannianae* that are the progeny of sistentes reproduce in the same summer [*cf.* **25** 726], those of *C. prelli* do not. The most important ecological difference, however, lies in the fact that *C. nordmannianae* predominantly infests young silver firs up to about 20 years of age, whereas *C. prelli* prefers the summits of older ones and develops only scantily or not at all on young trees.

The sistens larvae of *C. prelli*, the progeny of adult sistentes and alate migrants, remain latent up to autumn on the bark of summit branches of silver fir. Some fix themselves on the bark of shoots or near bud shoots, and others at the bases of blossom buds. Apparently owing to better nutrition, individuals of this second group develop quicker than the first, begin to moult in November, overwinter in the second or third instar, and oviposit in February. The average number of eggs deposited is greater than in the first group, and may be as high as 450. The eggs hatch early in April when the blossom buds of *A. nordmanniana* open, producing sistens and progrediens larvae. The former feed on the previous year's shoots, while the latter feed on the blossoms and develop into sexuparae that fly to oriental spruce. In 1934, the first sexuparae appeared on 28th April. Meanwhile the sistentes of the first group (those on the bark of vegetative shoots) hibernate in the first or second instar and often do not oviposit until the end of March, giving rise to both sistens and progrediens larvae. The former settle on both young and old shoots and the latter on young shoots. The sexuparae maturing on the needles of the young shoots begin to fly in mid-May.

The sexuparae migrate from the summits of the silver firs down to the lower branches of adjacent oriental spruce and there fix themselves to the underside of the previous year's needles and lay 12–15 eggs. The young sexuales hatch in about 8 days and begin feeding on the young needles. Their moults are completed in 2–3 weeks and the fertilised female lays its egg under the previous year's bud-scales at the base of the shoot. The first fundatrices appear early in June; those that are descendants of the sexuparae of the second flight period appear about 4 weeks later. They pass the summer as young larvae at the base of a young bud and usually moult in November and hibernate in the second instar. Oviposition begins in March, about 300–350 eggs being laid, and is completed by the end of April. The hatching of the young larvae is contemporaneous with the appearance of the gall buds, and the larvae crawl between the bud scales and are enclosed in gall cells. They have become alate migrants when the gall opens in mid-July or early August and releases them. They fly to the summits of silver firs, and oviposit, giving rise to young larvae of the sistens type.

Descriptions are given of the punctures made by *C. prelli* and of the resultant injury to the bark and inflorescences. Oriental spruce suffers little, as the fundatrices attack the secondary buds, but silver firs may be harmed by the sistens generation, which causes entire branches to wither, while the sexuparae on the inflorescences may kill the blossoms and thus destroy the seed crop. The severity of the

damage at Pillnitz is evidently due to several factors, including injury by smoke and the fact that the silver firs there are growing outside their natural area of distribution.

JANCKE (O.). **Traubenwicklerzucht im Laboratorium.** [Breeding of Vine-moths in the Laboratory.]—*Z. PflKrankh.* **47** no. 10 pp. 516–526, 3 figs., 9 refs. Stuttgart, 1937.

This paper includes lists from the literature of the recorded food-plants of larvae of the vine moths [*Clysia ambiguella*, Hb., and *Polychrosis botrana*, Schiff.] as observed in the field and in the laboratory, and a description of a technique by which *P. botrana* was bred from egg to adult at Neustadt. Vine twigs infested with mature larvae were collected and placed in glass cylinders, where the larvae pupated in corrugated cardboard. This was then transferred to metal-gauze cages, where the adults emerged and paired, feeding on sugar-solution. Fertilised females were transferred to small glass cages and oviposited either on the glass or on sand-paper. Newly-hatched larvae were placed on vine leaves lying on gauze stretched over a dish and covered with a smaller dish ; they fed and 50 per cent. pupated. The pupae were kept at 25°C. [77°F.], and some normal adults emerged. Larvae placed on various fruits and leaves of plants other than vine all died in a very few days. A subsidiary experiment showed that larvae taken from grapes could complete their development on vine leaves.

There are no records in the literature of *P. botrana* having previously been bred in the laboratory, but such breeding should facilitate the testing of insecticides.

NUNBERG (M.). **O wpływie różnych czynników na występowanie i populację strzygoni choinówki** (*Panolis flammea* **Schiff.**). [On the Effect of different Factors on the Occurrence and Population of the Pine Noctuid.]—*Trav. Inst. Rech. For. dom.* (A) no. 22, 56 pp., 1 diagr., 3 maps (1 fldg), 5 fldg pls., 22 refs. Warsaw, 1937. (With a Summary in German.)

An account is given of investigations on the effect of climatic conditions and types of forest on the occurrence of *Panolis flammea*, Schiff., in Poland [*cf. R.A.E.*, A **17** 494]. Examination of collections of pupae showed that the moth is present wherever pine is growing ; it is common and causes much damage in the west and north-west, and gradually becomes less abundant towards the east and south-east. The regions in which outbreaks occur are found to be characterised by an annual rainfall of 20–36 ins., but there are other forested areas with an annual rainfall of 20–28 ins. in which outbreaks have not occurred. The author believes that they are favoured by the cultivation of pure stands of pine over large areas, as is the case in western Poland. In the east and south, the forests approach natural conditions and are, consequently, only seldom infested, the trees also being more resistant to the attacks of pests. The tabulated results of a survey of the abundance of the moth in different localities during 1933–35, calculated by estimating the average number of pupae to a tree, showed a definite increase in the pupae in 1935 all over Poland, irrespective of the weather. According to observations by Eidmann in Germany, the maximum increase of the moth during 1924–33 usually occurred in years in which there was low temperature and abundant rainfall in

April–August. These findings appear to contradict the hypothesis that the increase of the moth is favoured by hot and dry weather during two years, severe outbreaks taking place in the third year.

The percentages of parasitism of pupae collected in various localities in the autumns of 1934 and 1935 were determined ; they were higher in 1935 where the weather in June and July had been fine and lower where it had been rainy. The percentages of parasitism in eggs and pupae were always higher in mixed stands than in pure ones.

FEYTAUD (J.). **La question doryphorique au début de la campagne 1937.**—*Rev. Zool. agric.* **36** no. 4 pp. 49–64, 1 map, 4 refs. Bordeaux, April 1937. [Recd. September 1937.]

The situation regarding the Colorado potato beetle [*Leptinotarsa decemlineata*, Say] in France at the beginning of the 1937 campaign is reviewed [*cf. R.A.E.*, A **25** 498]. A map of the areas infested at the end of 1936 shows that the beetle has spread over most of France, with the exception of several Departments in the south-east, and a strip of land of variable width along most of the Channel coast. Although infestation was recorded in 5 new Departments, none of these was seriously affected, and weather conditions were so unfavourable on the whole that no control measures were necessary in many districts where serious damage had been done in 1935. Large swarms of the adults were seen in several localities in July and August, and quantities of dead ones were washed up on to islands off the coast of Morbihan. It is feared that these flights may have considerably increased the range of the insect.

M[ELIS] (A.). **L'infuso di legno quassio nella lotta contro le *Hoplocampa* del susino.** [The Infusion of Quassia Chips in Work against Plum Sawflies.]—*Note Fruttic.* 15 no. 10 pp. 160–163. Pistoia, October 1937.

Lead arsenate is the insecticide usually employed in sprays against sawflies (*Hoplocampa*) attacking plum in Italy, but for some time growers in North Italy have obtained excellent results with an infusion of quassia chips [*cf.* also *R.A.E.*, A **25** 465]. An account is given of experiments in 1936 confirming this and showing that sprays prepared by infusing 3–4 lb. quassia chips in 20 gals. water reduce infestation more than sprays of lead arsenate (3–4 lb. per 100 gals.) and that the first application can be made at blossom time without harm to bees. It is considered best to make one application during blossoming, a second when nearly all the petals have fallen, and a third 18 days later.

MARTELLI (G. M.). **La protezione degli agrumi dalla *Ceratitis capitata* Wied., con sacchetti di carta a Tripoli.** [The Protection of Citrus Fruits against *C. capitata* by Means of Paper Bags.]—*Agric. libica* **6** no. 8 reprint 6 pp., 1 pl. Tripoli, August 1937.

Bags of parchment paper did not prove entirely satisfactory for protecting *Citrus* fruits against *Ceratitis capitata*, Wied., in Tripoli as they were damaged by rain and wind, about 20 per cent. of the fruits being uncovered in one instance, and furthermore interfered with ripening, colouring, etc. It is planned to experiment with square sheets of light blue cellophane tied round the fruits.

KENNEDY (J. S.). **Phase Transformation in Locusts in the Field.**—*Nature* **140** no. 3551 pp. 889–890, 1 fig. London, 20th November 1937.

In the winter of 1936–37, investigations were carried out in the outbreak centres of *Schistocerca gregaria*, Forsk., on the Red Sea Coast of the Sudan [*cf. R.A.E.*, A **24** 231], to elucidate the process by which phase *solitaria* is transformed into phase *gregaria* in the field.

For various reasons, including visual attraction, hoppers in the fourth and fifth instars tend to concentrate in patches of dense but uneven vegetation, such as unweeded millet cultivation. Here the sun's radiation produces a close patchwork of different temperatures, humidities and light intensities, and small patches of bare ground constitute the warmest and driest situations. The reactions of solitary hoppers to the temperature stimulus cause them to form loose basking groups on these bare patches. Such crowding together may have the same effect as breeding in densely populated cages [*cf.* **20** 671–672], and phase transformation would probably be impossible without the bare patches, however numerous the locusts became. Hoppers of phase *gregaria* were too active to remain together on the bare patches, so that bands tended to break up in unweeded cultivation. Such vegetation is therefore indispensable for the production of the phase *gregaria*, but the continued existence of the latter is only possible if the bands or swarms break out of it.

[SEMENOV (A. E.) & NIKIFOROV (A. M.).] **Семенов (A. E.) и Никифоров (A. M.). A new Pest of Flax.** [*In Russian.*]—*Len i Konoplya* **14** no. 4 pp. 9–11. Moscow, 1937.

Serious damage to flax in the Province of Krasnoyarsk (Siberia) was caused in 1935 by larvae of *Ceuthorrhynchus sareptanus*, Schultze, which had not previously been recorded as a pest of this crop. Field observations in 1936 showed that there is one generation a year, hibernation occurring in the adult stage in the soil at a depth of 2 ins. or less in fields of flax or in adjoining turf. The weevils were emerging over a period of about six weeks, beginning in mid-May when the average temperature was 10°C. [50°F.]. They fly about in search of food and feed on couch grass (*Agropyrum repens*) before the flax comes up. On flax, they skeletonise the leaves or make small holes in them. Eggs are laid in cavities made in the stems, the oviposition period extending from the time of appearance of the flax plants to the beginning of flowering. No eggs were found on couch grass. The larvae hatch in 7–12 days and mine in the stems, usually upwards ; as many as five may develop in a stem. The infested plants are either killed or develop shoots ; the stems are deformed and the fibre is poor or fails to develop. Pupation occurs in the soil at a depth of about 1½ ins., and the pupal stage lasts 18–20 days. In 1936, most of the young adults emerged in the first ten days of August and fed intensively on any available unpulled flax and sprouting self-sown plants before entering hibernation. The severest infestations, affecting from 20 to 96 per cent. of the plants, occurred in fields in which flax had been grown for several consecutive years, or along the edges of fields adjoining those that had been under flax in 1935.

It was evident from the results of ploughing in the autumn of 1935 that this practice considerably reduces the number of weevils surviving

in the soil. Destroying couch grass proved to be of value, as did early sowing of the flax, as this enabled the plants to be pulled earlier in the autumn and facilitated the control by insecticides of the young weevils feeding on any flax remaining in the harvested fields. Of the insecticides tested, a dust of 1 part calcium arsenite containing 60 per cent. As_2O_3 mixed with 3 parts talc was the most effective, killing 82 per cent. of the weevils when applied in autumn, immediately after the flax was harvested, at a rate equivalent to about 8 lb. calcium arsenite per acre.

Observations indicated that the distribution of *C. sareptanus* is similar to that of wild flax, which is presumably its primary food-plant.

GHOSH (C. C.). **The Pulse Beetles (Bruchidae) of Burma.**—*Indian J. agric. Sci.* **7** pt. 3 pp. 395–412, 2 pls., 12 refs. Delhi, June 1937.

The Bruchids that infest pulses of economic importance in Burma are *Bruchus chinensis*, L., *B. analis*, F., *B. phaseoli*, Gyll., and *B. albocallosus*, Pic. The damage caused is sometimes extensive; the various types of *Dolichos lablab* are so severely injured in store that they cannot be exported. The greatest damage is done, both in field and store, by *B. chinensis*, which especially attacks pigeon peas (*Cajanus indicus*) but also cowpeas (*Vigna catjang*), and by *B. phaseoli* to varieties of *Dolichos lablab*. *B. analis* is less injurious, and *B. albocallosus*, which occurs only in the field on *C. indicus* and sword beans (*Canavalia ensiformis*), cannot be considered a pest. Beans (*Phaseolus vulgaris*) are immune from these Bruchids, but lima beans (*P. lunatus*) are slightly attacked in storage. Peas and gram (*Cicer arietinum*) are not damaged severely, although not immune. The distribution of the Bruchids and the seeds they infest are briefly reviewed from the literature, and a list is given of 23 types of pulses that are damaged, showing their English, Burmese and scientific names, the specific Bruchids that attack each in the field and in store, and whether or not the injury is severe. Another list, given as an appendix, shows the results of tests of the susceptibility of 143 varieties and types of pulses to *B. chinensis*, *B. analis* and *B. phaseoli*.

Females of *B. chinensis* lay 38–53 eggs, several on each seed or pod. In experiments, the number of beetles emerging was rather less than that of the seeds on which oviposition had occurred, but up to 6 have been observed to emerge from a single seed. The length of the life-cycle differed in different types of seed; it varied from 20 days in *Cajanus indicus* to 189 days in Burma lima beans.

Females of *B. analis* from harvested cowpeas began to oviposit soon after emergence; 32–89 eggs are laid singly, several on each seed or pod. Only one beetle emerged from each seed. The length of the life-cycle varied according to the food between 18 and 107 days, both on strains of *Dolichos*.

In the field, eggs of *B. phaseoli* are laid in clusters of about 3–8, several clusters on one pod, but in storage they are deposited singly, several on each seed, and dry seeds are preferred to green ones. A female lays 38–137 eggs, and several beetles emerge from each seed. The life-cycle varied according to the food from 18 days on one variety of *Dolichos* to 122 days on one of lima beans. The beetles bred from lima beans were smaller in size and paler in colour.

B. albocallosus has only been obtained from pods collected in the field. Eggs are laid in the pods, and the beetles, on issuing from the seeds, cannot emerge from the pods until the latter burst. Beetles ready to emerge on 30th March were still alive in the pods on 10th May.

Some control of these Bruchids is obtained by spreading the seeds directly after harvest in a thin layer on a smooth surface plastered with mud and exposed to the sun. Germination of some seeds was affected by artificial heat at temperatures lower than those necessary to kill the larvae. Storage at low temperature (40°F.) lengthened the life and inhibited the breeding of adults of *B. analis*, but is impracticable for general use. Seeds of *D. lablab* were steeped in water for periods of 1 to 4 hours. Badly infested seeds floated at once, and less badly damaged ones swelled after some time. After 1–1½ hours' steeping most of the infested seeds can be separated. Storage of the seeds under sand is a simple and effective method of preventing infestation.

PRUTHI (H. S.). **On the *Pyrilla* Pest of Sugarcane in India.**—*Indian J. agric. Sci.* **7** pt. 3 pp. 511–512, 3 pls. Delhi, June 1937.

Three supposedly distinct species of *Pyrilla*, recorded from identifications originally made by Distant as *P. perpusilla*, Wlk., *P. aberrans*, Kby., and *P. pusana*, Dist., are common pests of sugarcane in India. Observations at Pusa showed that *perpusilla* was most abundant from April to June, *aberrans* from June to August and *pusana* after mid-August. The last two, however, paired freely with each other, and examination showed that, anatomically and in colouration, they represented the ends of a series comprising several intermediate forms. Their male genitalia were found to be identical and differed only slightly from those of *perpusilla*. Individuals of all three forms were compared by W. E. China with the type specimens available in the British Museum, and from the comparison it is evident that the Pusa specimens identified as *P. aberrans* differ from the type of this species described from Ceylon; further investigations showed that all the specimens of Distant's *P. aberrans* in Indian collections were *P. pusana*. There is no record of the true *P. aberrans* in India.

The similarity of the male genitalia of *pusana* and *perpusilla* suggests that the former is a variety of the latter. However, in view of the doubtful correctness of Distant's identification of *perpusilla*, the type specimen of which was collected in Bengal and is not available for comparison, the two species are provisionally kept distinct.

EVANS (J. W.). **The Light-Brown Apple Moth** (*Tortrix postvittana* **Walker**).—*Tasm. J. Agric.* **8** no. 3 Suppl. 18 pp., 6 figs., 14 refs. Tasmania, August 1937. (Abridged in *Tasm. J. Agric.* **8** no. 3 pp. 125–128, 3 figs. Tasmania, August 1937.)

This account of *Tortrix postvittana*, Wlk., on apple in Tasmania is based on observations begun in March 1935, some of which have already been noticed [*R.A.E.*, A **25** 290; *cf.* also **21** 91]. It has been found feeding on the leaves of *Eucalyptus*, *Acacia*, pine, oak and chrysanthemum, and causes slight damage to apricots when these are grown next to apples. When abundant it may cause a loss of 25 per cent. of the apple crop. Fruits that have short stalks and tend to form close clusters are the most liable to attack, and field observations

suggest that eggs are laid most frequently on trees with thick foliage. When the larvae feed on the fruit they seldom cause deep blemishes, although they may bore into the core for shelter, and may severely damage stored fruit. When they first begin to feed, they usually settle on the lower surface of a leaf, spin a protective web against the midrib or a vein, and feed completely under cover. Early in the third instar, they abandon these tunnels and web together the two sides of a partly folded leaf or two adjacent leaves to form a shelter, in which they eventually pupate. They occur principally on the vertical shoots, especially on the tender terminal leaves. Single leaves may support many larvae in the first two instars, but usually only one in a later instar. Feeding on fruit takes place only when overcrowding on the shoots has forced the larvae to wander. In one orchard where summer pruning of the terminal shoots was carried out in January 1936, moths caught in bait-traps in November and December 1935 were less numerous than those of the next generation caught in February and March 1936, suggesting that many larvae were feeding elsewhere than on the shoots.

Under laboratory conditions, fertilised females began to oviposit on the third day after emergence, the numbers of eggs in a batch averaging 20. In the field they averaged 12. The greatest number of eggs recorded from a single female was 232. The egg stage lasted 9–13 days and the larval stage 41–62 days. An important factor in control is that at an average temperature of 60°F. the first two instars, in which the larvae are most susceptible to sprays, last not less than 14 days.

The percentages of fruit of 8 apple trees injured in the seasons ending in 1935, 1936 and 1937 were 15, 25 and 8, respectively. Catches in bait traps showed that the moths were more abundant and emerged nearly 3 weeks earlier in 1935 than in 1936. There were no significant differences in the spring temperature readings, but the rainfall from January to April, inclusive, was considerably greater in 1935 than in 1936. Summer and winter rainfall may perhaps increase the numbers of overwintering larvae by washing the spray deposit from the leaves, delaying leaf fall, and encouraging an abundant growth of weeds. Leaf fall was earlier in 1934 and 1936 than in 1935.

In laboratory experiments on control, a spray of miscible white oil was only effective against eggs in the early stages of development, but a spray of this oil and nicotine sulphate, 8 : 1 : 640, caused complete mortality of eggs in all stages. Field experiments showed, however, that ovicides were of little practical value, owing to the necessity for accurate timing or frequent applications. A spray containing thiodiphenylamine was effective only against larvae in the first two instars. Lead arsenate is not very effective against the later instars [*cf.* **25** 295]. A series of field tests with lead arsenate, 10 lb. in 300 gals. water, showed that about 99 per cent. control could be obtained by 5 sprays applied at fortnightly intervals starting with the calyx spray. If fewer sprays have to be applied, it is better to omit the last one or two rather than the intermediate ones. During the winter, orchards should be kept as free from weeds as possible and no apples should be left on the trees. Cover crops should not be planted in every consecutive season. When practicable, all leaves left on the trees in the first week of June should be removed. Summer-pruning is not effective.

As the moth, although indigenous, is never as conspicuously abundant on the native vegetation as it is in orchards, it is probable that its parasites have not become adapted to the latter habitat. It is thought, too, that on evergreens there may be 3 generations in the annual cycle of the moth, and the 2 generations in the orchards may not synchronise with those of the parasites. During this investigation, the most abundant parasite was the Tachinid, *Voriella uniseta*., Mall., which has a pupal stage identical with that of the host, and which has been found in January and February. Other parasites reared were *Brachymeria* (*Chalcis*) *rubripes*, Gir., and *B.* (*C.*) *victoriae*, Gir. Batches of eggs parasitised by *Trichogramma* sp. were found in one locality in January. Three unidentified Braconids were bred from *Tortrix* larvae, but *Apanteles tasmanica*, Cam., which was originally described from Tasmania, and which is the most important parasite in New Zealand [**24** 209] was not observed.

The only other Tortricid found on apple during this investigation was *Acropolitis rudisana*, Wlk. (*rudis*, Meyr.), which occurred in 2 localities in 1935.

Gomez-Menor (J.). **Actividades de control biológico en la Rep. Dominicana.** [Biological Control Work in the Dominican Republic.]—*Rev. Agric.* **23** no. 95 pp. 372–374. Ciudad Trujillo, August 1937.

In 1929, a few examples of *Chilocorus cacti*, L., were introduced from Cuba and released in Santo Domingo for the control of *Aspidiotus destructor*, Sign., on coconut, but this Coccinellid did not become established. Two others, *Pentilia castanea*, Muls., and *Cryptognatha nodiceps*, Mshl., however, have also been imported against the scale ; they have been bred and distributed and are thought to be established. It is planned to introduce the Encyrtid, *Dasyscapus parvipennis*, Gah., against various thrips.

Pickles (A.). **Report of the Entomologist for the Year 1936.**—*Rep. Dep. Agric. Trin. Tob. 1936* pp. 57–58. Trinidad, 1937.

A survey in Trinidad in 1936 showed that 0·64 and 2·63 per cent. of the internodes of sugar-cane were infested by *Castnia licoides*, Boisd. (*licus* auct.) and *Diatraea* spp., respectively, and that the latter species also caused a greater loss of sugar at the factory. *Metagonistylum minense*, Tns., was introduced from British Guiana for the control of *Diatraea* and has been recovered from the fields where it was liberated. The froghopper [*Tomaspis saccharina*, Dist.] caused more serious damage to sugar-cane in the northern districts than it has since 1931. Pyrethrum sprays and dusts killed 70 per cent. of the adults of this Cercopid, and it is thought that the mortality rate could be increased with improved equipment. Preliminary experiments indicated that Uba was the most resistant variety of sugar-cane, while Co 213 was not significantly more resistant than B.H. 10/12 [*cf. R.A.E.*, A **25** 253].

The cacao thrips [*Selenothrips rubrocinctus*, Giard] occurred over considerable areas and contributed to a serious shortage of the cacao crop. Green fruits of bananas were scarred by black stingless bees (*Melipona* spp.), which pierce the skin to get latex. *Prontaspis citri*, Comst., and *Lepidosaphes* spp. on *Citrus* were found to reproduce more rapidly in the dry season than in the wet season, so that sprays applied

in the former period are more valuable. Stinging ants in the plantations were much attracted by a bait of sweet jelly poisoned with thallium sulphate.

In experiments on the storage of maize and cowpeas, fumigated material was stored for 8 months in tins or bins beneath a covering of fine sand without appreciable deterioration. Omission of fumigation or of the sand covering quickly led to infestation by insects [*cf.* **25** 17] followed by mildewing and complete destruction of the grain. Storage in bags, with or without fumigation, did not protect the grain from insect attack, but mildewing was not serious. The species of *Ephestia* that infests cured cacao in city warehouses has also been found in drying sheds and storerooms on the cacao estates, where it is able to reproduce in débris in the cracks and crevices of the buildings and so can infest cacao before it leaves them.

HERNANDEZ OLMEDO (I.). **El picudo o "nixtamalillo"** (*Epicaerus cognatus*). [The Potato Weevil.]—*Agricultura* **1** no. 1 pp. 8–12, 4 figs. Mexico, D.F., July 1937.

Though *Epicaerus cognatus*, Sharp, is a native of Mexico, it did not attract attention until 1922, when Mexican potatoes infested by it were intercepted in New Orleans. The larva and adult of the weevil are described, and notes are given on its distribution in Mexico. Investigations on its bionomics were made in the period 1929–31.

The adults emerged from the soil in May, mostly during the first fortnight, and females oviposited several times on potato foliage between May and October, mainly in July and August. The most frequent number of eggs per batch was 10–15. The surviving males and females hibernated in cracks in the ground, under leaves, etc. In experiments, adult weevils collected in the field in August emerged from hibernation in April, paired and oviposited, and some hibernated again and oviposited in the third summer. The egg stage lasted from 11 to 40 days under varying conditions of temperature and humidity, and 18–20 days under normal conditions. The newly hatched larvae dropped to the ground and entered the soil in search of a tuber in which to tunnel. Tubers were found infested at a depth of 8 ins., but not at 12 ins. After feeding in the tubers for 3–5 months, the larvae left them and formed cells in the soil, in which they invariably remained until March, when they pupated. In the field, the adults fed exclusively on potato foliage, but in the laboratory they accepted lettuce and *Bidens*. The control measures advised are the use of uninfested seed potatoes, crop-rotation, immediate lifting of the crop and its storage in silos, destruction of the larvae in the earth at the bottom of the emptied silo, spraying the leaves with calcium arsenate in May and June or hand collection of the adults, and using infested potatoes as food for pigs.

DE LA TORRE-BUENO (J. R.). **A Glossary of Entomology.**—Demy 8vo, ix + 336 pp., 9 pls., 34 refs. Brooklyn, N.Y., Brooklyn ent. Soc., 1937. Price $5.00.

This glossary is based on "An Explanation of Terms used in Entomology" by J. B. Smith (1906), which has been completely revised and rewritten. The terms included are those used in all

branches of zoology where insects may be considered, some used in chemistry, physics, botany and medicine, and a very few used in mathematics. With most of the older terms that have been anglicised, the Latin form is also shown, and many other Latin forms are given. There are no words in other languages with the exception of a few that have come into standard English usage. As a rule, the use of the terms defined may be found in the works listed in the bibliography, and the authority for the word defined is added in parentheses at the end of the definition. Special usages in various groups of insects are shown as well as general applications. The arbitrary signs and symbols used in entomology, and a list of Latin abbreviations are included in appendices, and a final series of plates show the names of the chief anatomical structures in insects, with particular reference to Rhynchota and Lepidoptera.

Payne (N.). **The differential Effect of environmental Factors upon** *Microbracon hebetor* **Say (Hymenoptera : Braconidae) and its Host,** *Ephestia kühniella* **Zeller (Lepidoptera : Pyralidae). III. Effect of the Sting of the Parasite and of two chemical Agents on the respiratory Rate and Quotient of the Host Larvae** (*E. kühniella* **Zeller).**—*Biol. Bull.* **73** no. 1 pp. 147–154, 5 refs. Lancaster, Pa, August 1937.

The following is taken from the author's summary of this paper, which is one of a series [*cf. R.A.E.*, A **22** 349] : Larvae of *Ephestia kuehniella*, Zell., when stung by the parasite, *Microbracon hebetor*, Say, become soft, flaccid and motionless. Associated with the flaccidity is a greatly lowered respiratory rate through the temperature range used, namely 10 to 32°C. [50–89·6°F.]. The sting also greatly decreases the sensitivity of the larvae to change in temperature, but does not affect the respiratory quotient.

Osborn (H. T.). **Vein-mosaic Virus of Red Clover.**—*Phytopathology* **27** no. 11 pp. 1051–1058, 3 figs., 6 refs. Lancaster, Pa, November 1937.

An account is given of investigations in New Jersey of the host range, properties and method of transmission of the virus that produces a yellowing of the veins (vein-mosaic) in red clover (*Trifolium pratense*). The virus was maintained continuously in a greenhouse by successive transfers to red clover by colonies of the pea aphis [*Macrosiphum onybrychis*, Boy.] and to broad beans (*Vicia faba*) by mechanical inoculation. It was also transmitted by *M. onobrychis* to broad bean, sweet pea (*Lathyrus odoratus*) and white, alsike and crimson clovers (*T. repens*, *T. hybridum* and *T. incarnatum*). Symptoms in red clover were observed in some cases within 14 days after inoculation by colonies of the Aphid, but in others did not occur for 6 weeks or more. Experiments showed that the Aphids could acquire and transmit the virus in a total period of two hours, and that colonies continued to be infective after feeding periods of one hour on healthy plants, but lost the virus when fed on such plants for 24 hours. Transmission experiments with *M. solanifolii*, Ashm. (*gei*, auct.) and *Aphis rumicis*, L., gave negative results.

Walker (H. G.) & Anderson (L. D.). **Control of Cabbage Worms.**—*Bull. Va Truck Exp. Sta.* no. 93 pp. 1381–1394, 1 fig., 1 ref. Norfolk, Va, October 1936. [Recd. September 1937.]

Brief notes are given on the bionomics of *Plutella maculipennis*, Curt., *Plusia* (*Autographa*) *brassicae*, Riley, and *Pieris* (*Ascia*) *rapae*, L., attacking cabbage and other cruciferous vegetables in Virginia, and of *Hellula undalis*, F., which caused some injury in 1932, together with an account of experiments on their control carried out since that year [*R.A.E.*, A **22** 402 ; **25** 690]. *Plutella maculipennis*, which has been the most injurious of these pests, may have 7 or more generations during the year in south-eastern Virginia, but when the larvae become numerous, parasitism by *Angitia polynesialis*, Cam. (*hellulae*, Vier.) often brings control. In the early winter of 1934 and the spring of 1935, over 95 per cent. of the larvae were parasitised, but heavy losses occurred in 1936 before they were controlled. The egg and larval stages of *A. polynesialis* within the host together last about 8 days, and the pupal stage lasts 9–10 days. The females can reproduce parthenogenetically, producing male offspring. Of 382 parasites reared from pupae collected in the field, 232 were females. In 1935, the hyperparasite, *Eupteromalus viridescens*, Walsh, was reared from an average of 10 per cent. of the cocoons of *A. polynesialis* collected from different localities.

Landis (B. J.). **Insect Hosts and Nymphal Development of *Podisus maculiventris* Say and *Perillus bioculatus* F. (Hemiptera, Pentatomidae).**—*Ohio J. Sci.* **37** no. 4 pp. 252–259. Columbus, Ohio, July 1937.

The results are summarised of experiments carried out in Ohio on the effect of the host on the growth and mortality of nymphs of the second and subsequent instars of *Podisus maculiventris*, Say, and *Perillus bioculatus*, F. These Pentatomids are phytophagous in the first instar and predacious after the first moult. Nymphs of *Podisus* rejected the eggs of *Epilachna varivestis*, Muls., and *Lema trilineata*, Ol. ; when fed on eggs of *Leptinotarsa decemlineata*, Say, from potato and *Solanum dulcamara*, respectively, one of four and none of nine completed development. The rate of development appeared to correspond to that of the host fed upon. Body fluids of host larvae having a short larval period seemed to be more nourishing than of those having a long one, so that nymphs reared on *Plutella maculipennis*, Curt., *Crioceris asparagi*, L., *Lema trilineata*, and *Leptinotarsa decemlineata* completed their development in that order. The species or stages of hosts causing the most rapid development of the nymphs did not produce the greatest number of adult predators, but in most cases where the rate of development was relatively slow the mortality was extremely high. Nymphs reared on larvae of *L. decemlineata* that had fed on *Solanum carolinense* developed more slowly (24 days) and with greater mortality (89·3 per cent.) than those reared on larvae fed consistently on other plants. Toxic substances appear to be obtained indirectly from the food-plants of the host larvae. *S. atropurpureum* was extremely toxic to nymphs of *Podisus*, but much less so to nymphs of *Perillus*. The former developed slowly on larvae reared from *S. dulcamara* and the nymphal mortality was higher than that of nymphs reared on larvae from potato, tomato and egg-plant.

Nymphs of *Perillus* consumed an average of 231·5 eggs of *L. decemlineata* each during the 4 predacious instars, and 451·7 eggs of *Lema trilineata*, on which development was slower and the resulting adults much smaller. They developed more rapidly and with less mortality on larvae of *L. trilineata* or *C. asparagi* than on larvae of *Leptinotarsa decemlineata*. The development of those fed on larvae of *Leptinotarsa* was most rapid when the hosts had been reared on *S. dulcamara* and slowest when they had been reared on *S. carolinense*. Mortality was greatest on larvae from *S. carolinense*.

Britton (W. E.). **Connecticut State Entomologist, Thirty-sixth Report 1936.**—*Bull. Conn. agric. Exp. Sta.* no. 396 pp. 289–415 & xi–xvi, 34 figs., many refs. New Haven, Conn., May 1937.

Britton gives an annotated list (pp. 294–310) of insects recorded in Connecticut during 1936. Work against *Lymantria* (*Porthetria*) *dispar*, L., reported by Britton, J. T. Ashworth and O. B. Cooke (pp. 330–339), followed the same lines as that in 1935 [*R.A.E.*, A **24** 657], but was more extensive, nearly 800,000 acres being surveyed. In a section on the control of *Pyrausta nubilalis*, Hb. (pp. 340–345), M. P. Zappe, N. Turner and J. C. Schread report experiments in which maize was planted at intervals of 10 days from 20th April to 10th July. All maize maturing between 11th and 25th July and mid-season and late maize maturing before 7th August were at least moderately infested. Early varieties maturing between 25th July and 20th August, and mid-season and late maize maturing between 7th and 24th August were relatively free from infestation. The second-generation borers caused moderate damage to maize maturing between 24th August and 11th September. Mass-colonisation of *Trichogramma* did not give satisfactory results. A heavy infestation of potatoes by *P. nubilalis* in various fields is recorded by Turner and Zappe (pp. 345–346). J. P. Johnson reports (pp. 346–351) that infestation by *Popillia japonica*, Newm., was general at original sites, and in three places showed a marked increase ; baited traps in districts not known to be infested yielded 16 beetles from 6 towns.

Notes on Hymenopterous parasites of insects infesting elm are given by B. J. Kaston (pp. 351–361). Adults of *Spathius canadensis*, Ashm., were taken from 12th June to 24th September in a number of localities, and individuals reared from elm material from several others [*cf.* **25** 37]. Adults from *Magdalis barbita*, Say, and *M. armicollis*, Say, are much larger than those from *Hylastes* (*Hylurgopinus*) *rufipes*, Eichh., which vary considerably in size. Larvae of at least the last three instars are attacked. The cocoon and pupa and the process of pupation and emergence of the adult are described. *S. canadensis* probably has two generations a year ; the pupal period lasted 9 days. A species of *Heterospilus* was obtained from larvae of *Eutetrapha* (*Saperda*) *tridentata*, Ol., and occasionally of *Hylastes rufipes* ; there were usually 3 or 4 cocoons per gallery when the host was *Eutetrapha*, but only 1 when it was *Hylastes*. The males emerged 8 days, and the females 9 days after pupation, and pairing took place within 1 or 2 days. *Atanycolus ulmicola*, Vier., seems to be the commonest parasite of *E. tridentata* in Connecticut. The pupal stage lasts 7 days, adults emerge from late May to mid-July, and there appears to be one generation a year. Other parasites of *E. tridentata* were *Capitonius saperdae*, Ashm., the pupal stage of which lasts 9–11 days, the adults emerging from late

May to early August, and *Xorides albopictus*, Cress., adults of which emerge from mid-May to early July, and again about the middle of September. All these species overwinter as prepupae within the cocoon, which is described in each case. Figures are given of their cocoons and pupae, and of the prepupal heads of all except *C. saperdae*, and keys to the cocoons and pupae of the last four. *Trigonura hicoriae*, Rohw., was reared in early June from material infested with *M. barbita* and *M. armicollis*. There is no cocoon. A list is given of 9 other parasites known to have emerged from or oviposited in elm, though the host was not definitely ascertained, and 10 species collected from the surface of elms but not known to have parasitised insects infesting them.

Britton reports (pp. 361–364) that Carolina poplars in various districts were wholly or partly defoliated by *Stilpnotia salicis*, L. It has not been observed to attack any other tree in Connecticut. Notes are given on its bionomics, natural enemies and control [*cf.* **15** 671].

In a section on tests of apple sprays (pp. 364-366), Zappe and E. M. Stoddard report the results of continued investigations of sprays suitable for varieties of apple susceptible and resistant to scab [*cf.* **24** 658]. Sprays of lead arsenate (3 lb. in 100 U.S. gals.) were combined with three different sulphur fungicides for application to McIntosh apples and (together with lime) with three different adhesives for application to other varieties. Good control of chewing insects, of which the chief was *Conotrachelus nenuphar*, Hbst., and, on the McIntosh apples, of scab was obtained, and there was no significant difference in the results that could be attributed to differences in the constituents of the sprays.

Zappe (pp. 367–370) reports seven infestations of *Calomycterus setarius*, Roel. [*cf.* **24** 426, 659, etc.], one of which was new. The weevils were numerous, but not much more abundant than they had been in 1935. Sifting soil from various localities yielded larvae in almost all cases. They were most abundant among roots of golden rod [*Solidago*], and were plentiful later in hay fields among grass and clover roots. When reared, some proved to be *Otiorrhynchus* (*Brachyrrhinus*) *ovatus*, L., and others *C. setarius*. The first pupae of *C. setarius* were found in the soil on 10th June and a few soft adults on 16th June. On 23rd June, 80 per cent. of the immature forms were pupae, and adults were abundant on *Lespedeza capitata* (bush clover) and *Desmodium canadense*. During July and early August, the adults were plentiful on houses [*cf.* **24** 33] and vegetation, especially leguminous plants. Dissection showed that eggs were mature in greatest numbers between 15th July and 15th August, and that females from houses contained about as many eggs as those collected from the field. The height of egg deposition is probably at this period, and small larvae were found in the soil during the last week in September.

Turner describes injury done to dahlias by *Empoasca fabae*, Harr. (pp. 370–371). In comparative tests, plants sprayed with Bordeaux mixture on 13th and 25th July and 7th August were the least damaged [*cf.* **23** 553]. Derris dust (0·6 per cent. rotenone) with a clay carrier applied on 13th and 25th July was not effective, but talc alone [*cf.* **25** 692] on the same dates prevented serious injury.

A series of papers by P. Garman deals with the control of orchard pests (pp. 372–387). Serious injury to apple by *Paratetranychus pilosus*, C. & F., was shown to be correlated with the use of sulphur sprays or dusts, which killed Gamasid mites that were predacious on

it and were the only natural enemies of any importance in July. Tar oils and oils containing cresylic acid reduced the population of predacious mites more than other dormant oils, but effective numbers remained on trees receiving no additional sulphur sprays. Lime-sulphur also reduced the numbers of predacious mites. Summer oil emulsions with 1 to 1·5 per cent. oil content were equal or superior to other materials tested for the control of *P. pilosus*. An effort to increase the kill of summer eggs by the addition of a thiocyanate to the oil was not uniformly successful. When the infestation became serious in late June or early July, more than one application of summer oil was often needed to control it. Applications at intervals of about a month appear to be satisfactory. It is advisable to wait for a month after the application of lime-sulphur before applying summer oil, but after a wettable sulphur, a fortnight's interval resulted in only minimum leaf-scorch. Parasites liberated for the control of *Cydia* (*Grapholitha*) *molesta*, Busck, included several thousand each of *Microdus* (*Bassus*) *diversus*, Mues., *Angitia* (*Dioctes*) *molestae*, Uch., *Macrocentrus ancylivorus*, Rohw., and *Perisierola angulata*, Mues., and over a thousand of 8 different foreign species, 6 of them new to the State. The population of *C. molesta* was low in peach twigs in June and parasitism by larval parasites low in July. Subsequent infestation was not so heavy as was anticipated. It is believed that *A. molestae* had successfully survived the winter of 1935–36. Limited recoveries were made of this species and *Microdus diversus*. Breeding of a stock of the pupal parasite, *Phaeogenes haeussleri*, Uch., was begun with a view to its release in 1937. During 1936, 11 million *Trichogramma* were distributed. In continued experiments on the control of *Rhagoletis pomonella*, Walsh, carried out with flies kept at 76°F. and 60–70 per cent. relative humidity, mortality of adults confined with apples treated with a 0·75 per cent. rotenone dust and sprays of derris, lead arsenate, calcium arsenate, basic zinc arsenate, cryolite (Alorco [*cf.* **24** 297]) and thiodiphenylamine (phenothiazine), all at the rate of 3 gm. with 3 gm. wheat flour in 800 cc. water was 100, 90·9, 84·1, 60, 71·1, 54·5 and 57·6 per cent., respectively, in 20 days, and the number of egg punctures per female 0·18, 0·68, 3·3, 4·8, 3·7, 4·6 and 7·9. The dust had given complete mortality in 14 days. The apples were replaced with freshly treated ones after 10 days. In the control, mortality was 19·6 per cent. and there were 40·7 egg punctures per female. Dormant oils and lime-sulphur mixtures were compared as ovicides for a tent caterpillar [*Malacosoma americana*, F.]. A mixture of 4 per cent. oil with 0·125 per cent. nicotine sulphate and lime-sulphur (1 : 8) were the best, allowing 5·9 and 14·3 per cent., respectively, of the egg-masses to hatch. In tests in a peach orchard during 1935 and 1936, lime-sulphur was more effective than oils without nicotine. There was very little difference between lead arsenates of high and low water-soluble arsenic content with zinc sulphate and lime as a safener and wettable sulphur as a fungicide compared in tests of insecticides for peach, but the latter caused slightly less scorching and leaf-fall. Cryolite damaged the leaves much less than lead arsenate; dry flotation sulphur was the fungicide used. Lead arsenate with zinc sulphate and cryolite with sulphur gave about the same control of *Conotrachelus nenuphar*. One application was made at shuck-fall and one two weeks later. Tar oils as dormant sprays for the control of *Anuraphis roseus*, Bak., on apple were more satisfactory than oil with cresylic acid, which was probably applied too early, or than a miscible

oil applied at the delayed dormant period. In tests on *Aphis rumicis*, L., of various nicotine salts and wetting agents for them, nicotine salicylate appeared slightly more toxic than nicotine sulphate, but the results as a whole indicated that the toxicity of such compounds depends largely on the nicotine content and can only be increased within narrow limits by changing the nature of the salts or wetting agents.

Reports by R. L. Beard (pp. 387–392) deal with insects attacking squash. *Anasa armigera*, Say (horned squash bug), of which only one individual had previously been taken in the State (in 1919), constituted 28·8, 6·5 and 2·5 per cent. of the squash bugs collected on three farms. Characters distinguishing eggs and adults from those of *A. tristis*, DeG., and a description of all nymphal instars are given. Adults were first observed on 29th May, and caged females began to oviposit on 3rd June. Though the appearance of the ovaries was practically the same in *A. tristis*, fewer eggs were laid in the field than was expected, and, of 6 females caged on squash, 2 did not oviposit and none laid more than 33 eggs. Under the same conditions, females of *A. tristis* laid 55–184 eggs. The development of one group took from 9th June to 6th August, the egg stage and 5 nymphal instars lasting, respectively, 16, 6, 7, 6, 8 and 15 days. Five individuals of *A. repetita*, Heid., were taken during the summer, on summer squash and cultivated cucumber.

In tests against adults of *Diabrotica melanocephala*, F. (*vittata*, F.) on squash plants in cages, derris and clay dust (0·6 per cent. rotenone) and pyrethrum dust containing 2 per cent. pyrethrins with talc (1 : 9) both gave 100 per cent. mortality in 24 hours. A spray of derris (1 : 200) with a spreader gave 97·9 per cent. kill. A commercial rotenone spray and calcium arsenate were inferior. Mortality among controls was 1·1 per cent. When fresh beetles were allowed to feed for 48 hours on the same plants 5 days later, only the derris dust gave higher mortality (37·7 per cent.) than the control (20·4 per cent.). The same insecticides with the exception of pyrethrum were tested on squash in the field. Only the derris dust killed many beetles. Its action was very rapid. There was no perceptible difference between derris and cubé dusts containing 0·6 per cent. rotenone.

Turner, Zappe and J. F. Townsend (pp. 392–396) report that termites or damage by them was found in 116 out of 165 buildings examined because the owners suspected infestation, and that of 144 public buildings with masonry and concrete floors and 318 with wooden floors or framework, none of which was known to be infested, 24 and 102, respectively, were found to have termites present and 0 and 12 to be seriously damaged. The causes of infestation in the two cases are reviewed. An examination of buildings into which metal shields had been installed failed to reveal any reinfestations.

Miscellaneous pests on which notes are given by several of the above authors (pp. 399–411) include *Pomphopoea sayi*, Lec., very abundant locally on lupins; *Zonosemata electa*, Say, on peppers [*Capsicum*]; *Trichiocampus viminalis*, Fall., which infested nearly all the Carolina poplars in a district where almost all had been practically defoliated earlier in the season by *Stilpnotia salicis*; adults of the flea-beetle, *Chalcoides* (*Crepidodera*) *helxines*, L., and the weevil, *Ithycerus noveboracensis*, Forst., both of which are polyphagous, on peach; *Neotetranychus buxi*, Garman [*cf.* **23** 312] on box [*Buxus*]; and *Anobium punctatum*, DeG., which had not previously been recorded from Connecticut, boring joists and flooring of a house of native timber;

G. H. Plumb reports (pp. 410–411) that a number of Scots pines [*Pinus sylvestris*] found in a moribund condition proved to be partially or entirely girdled at the root crown by *Hylobius radicis*, Buch., the adults of which probably emerge from hibernation in the spring and oviposit in the soil near the base of the tree. The larvae construct galleries in the bark and feed in them until the following spring, when they leave the tree and pupate in the surrounding soil. The adults emerge in late summer and hibernate in late autumn. B. H. Walden states (pp. 403–404) that adults of the Melolonthid, *Diplotaxis atlantis*, Fall, fed in great numbers on the foliage of newly-planted strawberries, though two older fields nearer to brush land were not injured.

MACKIE (D. B.). **Entomological Service.**—*Bull. Dep. Agric. Calif.* **25** (1936) no. 4 pp. 455–481, 6 figs. Sacramento, Calif. [1937].

During 1936, there was considerable extension of the areas in California under regulation for the eradication of certain pests, but there was a reduction of 18 per cent. in the area treated for citrus whitefly (*Dialeurodes citri*, R. & H.). The date scale (*Parlatoria blanchardi*, Targ.) has now been finally eradicated [*R.A.E.*, A **24** 803], and the project discontinued. *Lepidosaphes halli*, Green, was found on a few large peach and apricot trees, and these were fumigated with hydrocyanic acid gas in the daytime under gas-tight tents, using 5 oz. sodium cyanide per 100 cu. ft., the air in the tent being warmed to 100°F. immediately before treatment. The trees were not injured and bore a crop. A thorough survey showed only one infested property, but an apparently undescribed species of *Lecanium* was taken on almond. This scale overwinters on the twigs as a nymph covered with regular rows of waxy knobs. In March, the males began to develop under white waxy-knobbed exuviae and the females began to enlarge. Eggs were laid before April and young individuals apparently spent the summer on the almond leaves. Parasitism by *Blastothrix sericea*, Dalm., was heavy, and the scales became bituberculate as a result ; some eggs were laid by parasitised females. The infestation of walnuts and pecans by *Chrysomphalus obscurus*, Comst., continued in spite of control measures ; it is believed that the effect against it of a spray of heavy oil (85 viscosity and 95 per cent. unsulphonated residue) was increased by the addition of a paraffin wax emulsion [*cf.* **24** 780]. The region in central California where lucerne is infested by *Hypera variabilis*. Hbst. (*Phytonomus posticus*, Gyll.) has extended to the east and north. In one field from which a new infestation was reported, 75 per cent. of the weevil cocoons were parasitised by *Bathyplectes curculionis*, Thoms. The population of the European earwig (*Forficula auricularia*, L.) has decreased since 1934. During the year, methyl bromide was used extensively as a fumigant [**25** 698].

After emerging from hibernation, the adults of the elm leaf beetle [*Galerucella luteola*, Müll.] feed on elm leaves for about a month before ovipositing, and sprays should be applied in this period. The addition of acid blood spreader to oil emulsions of the paste type employed against the European elm scale [*Gossyparia spuria*, Mod.] increases their efficiency. *Stomacoccus platani*, Ferris, on plane may be controlled by a dormant spray of 4 per cent. tank-mix oil with acid blood spreader.

The infestation of grasshoppers [*cf.* **24** 662] continued. *Melanoplus devastator*., Scudd., was injurious for the first time since 1919 [*cf.* **8** 47],

invading 200 square miles of dry grass lands on the slope of the Sierra Nevada. The clear-winged grasshopper [*Camnula pellucida*, Scudd.] caused damage in the north and in the south-east, where it infested land even at elevations of over 5,000 ft. ; hatching was prolonged as the soil at different elevations in turn reached the necessary temperature. *M. mexicanus*, Sauss., caused injury mostly in the south-west. The habits of this species in California differ greatly from those recorded elsewhere ; it shows a preference for lucerne rather than grain fields for habitat and oviposition, and from lucerne it migrates to vegetables, including young lettuce. Other injurious species were *M. packardi*, Scudd., *M. femur-rubrum*, DeG., *M. marginatus*, Scudd., *Hippiscus californicus*, Scudd., *M. bivittatus*, Say, *Schistocerca vaga*, Scudd., and *Oedaleonotus enigma*, Scudd., which was the least numerous.

During the year the codling moth [*Cydia pomonella*, L.] was abundant on pears, possibly because the lead arsenate applied against it was washed off the fruit by heavy rains. Infestations of peach orchards by it were largely traceable to picking boxes stacked in the orchards before use. Injury by the peach borer [*Aegeria exitiosa*, Say] was not so severe as in previous years. Late ripening plums appear to be more heavily infested by the peach twig borer [*Anarsia lineatella*, Zell.] than earlier ones. Apricots and early peaches were damaged by adults of *Diabrotica soror*, Lec., which pitted the riper parts of the fruit. As they did not appear until the fruit was ripening, stomach-poison insecticides could not be employed. The green stink-bug, *Acrosternum hilare*, Say, a native species not normally destructive, caused such severe injury to peaches for tinning that in some areas the crop was not harvested. The pear blister mite [*Eriophyes pyri*, Pgst.] was responsible for serious local damage to pears, but no satisfactory control measures were developed. Sporadic outbreaks of *Erythroneura comes*, Say, and *Desmia funeralis*, Hb., occurred on vines ; larvae of the latter were parasitised by *Microbracon cushmani*, Mues., and a Tachinid. *Aonidiella* (*Aspidiotus*) *perniciosa*, Comst., infested the grapes on vines interplanted with prunes.

Eradication of wild lettuce (*Lactuca scariola*) and sow-thistle [*Sonchus oleraceus*], which are its chief wild food-plants in spring [*cf.* **21** 590] has reduced populations of the bean thrips [*Hercothrips fasciatus*, Perg.] by 85 per cent. Where winter peas are followed by beans in the same field, this thrips has increased to dangerous numbers in spite of control measures. Winged migrants of *Aphis rumicis*, L., flew from beans to sugar-beet, to which some damage was done. The corn earworm [*Heliothis armigera*, Hb.] was a major pest of field crops, particularly tomatos [*cf.* **24** 661]. An Aphid, probably *Pemphigus populitransversus*, Riley, attacked the roots of lettuces grown on several types of soil and caused some damage. There was evidence that infestation was heaviest near stands of willow. Most of the injury to cotton was caused by sucking insects, the chief of which was *Lygus elisus*, Van D. ; most leaf injury was caused by *Lycophotia margaritosa*, Haw., and some by *Bucculatrix thurberiella*, Busck.

The use of aeroplanes for applying insecticides increased during the year. The materials were generally applied in an effective manner, but sometimes wind interfered with the dispersal of dusts ; in one district bee-keepers lost 400 and 200 colonies at a time [*cf.* **25** 176]. The brown apricot scale [*Lecanium armeniacum*, Crwf.] was controlled by the application from aeroplanes or ground machines of finely divided particles of almost pure oil and oil-soluble insecticides.

Other insects observed during the year included *Aleurodes azaleae*, Baker & Moles, on azaleas, *Pseudococcus krauhniae*, Kuw., *Aonidiella aurantii*, Mask., and *Chrysomphalus dictyospermi*, Morg., on *Citrus*, *Aspidiotus ancylus*, Putn., on almond and walnut; *Carpophilus ricksecker*i, Fall, on tomatos, and *Aegeria* (*Synanthedon*) *opalescens*, Edw., on peach.

O'Kane (W. C.) & Conklin (J. G.). **Insect Record.**—*Bull. N.H. agric. Exp. Sta.* no. 296 (Rep. 1936) p. 17. Durham, N. H., May 1937.

No European elm bark-beetles [*Scolytus multistriatus*, Marsh.] were recovered from trap logs placed in 72 localities in New Hampshire with a view to obtaining data on possible vectors of Dutch elm disease [caused by *Ceratostomella ulmi*]. In two localities, a native bark-beetle was found. In the spring of 1936, the Geometrid, *Itame inceptaria*, Wlk., which had only been recorded in the State once previously (in 1886), defoliated blueberry and caused a serious reduction of the crop. An outbreak of *Pycnoscelus surinamensis*, L., in a greenhouse resulted in several thousand rose plants being destroyed. This cockroach strips the plants, including the epidermis from the stems, at night, and shelters in the soil during the day. Arsenical sprays were ineffective, but the application of a special nicotine spray to the soil gave a high degree of control. Delphinium plants in the south were seriously injured by *Tarsonemus latus*, Banks, which had not previously been recorded in New Hampshire. Heavy applications of sulphur dust were the best remedial measure.

Alsterlund (J. F.) & Compton (C. C.). **Effects of Nicotine Fumigation at short Exposure and assumed high Concentration.**—*J. econ. Ent.* **30** no. 4 pp. 571–575, 3 figs. Menasha, Wis., August 1937.

Greenhouse and field experiments in Illinois indicated that nicotine vapour is more effective against Aphids if a high concentration of fumes is built up for a relatively short period than if a weaker concentration is maintained for a longer time.

The Aphid in the greenhouse experiments was *Macrosiphum sanborni*, Gill., which is rather resistant to nicotine fumigation. Well-grown apterous individuals from chrysanthemum were fumigated in cages, for 1 hour at 70°F. and 59–82 per cent. relative humidity, with nicotine from Nicofume fumigating powder, which consists of 12·5 + per cent. by weight pure nicotine absorbed into a rapidly combustible base. The method tested was to burn the powder in cans placed along the paths of the greenhouse. Two holes are punched on opposite sides of each can and the powder is ignited by dropping in a lighter supplied for the purpose. The usual dosage of 1 lb. Nicofume per 25,000 cu. ft. gives high kills of most Aphids. Mortality by this method and by a modified one in which the pressure cans were moved slowly through the house while burning to give a fairly uniform low dosage, was erratic. Higher and more uniform mortality was obtained when 50 per cent. base powder was added to the commercial powder to prolong burning, and the mixture was distributed at the rate of 0·3 lb. commercial powder per 100 linear ft. of greenhouse bench by carrying the containers along the walks so that the fumes, emerging from a single hole, were directed at the foliage, building up a temporary

dense cloud around the plants. In a second test, cages were placed on two adjoining benches, of which one only was fumigated by this spot method with a dosage that would be extremely low when dispersed. Only the spot-fumigated cages showed any appreciable kill.

A description is given of the nicotine vaporiser, a new machine for the fumigation of low-growing crops with free nicotine, on which observations were made during the summer of 1936. A water solution containing 80 per cent. actual nicotine was used. A dosage of 2·31 lb. of 100 per cent. nicotine per acre was applied to peas infested with *M. onobrychis*, Boy. (*pisi*, Kalt.). A speed of a little more than 1 mile per hour gave a fumigation period of about 1 minute. In 8 representative plots treated on 22nd, 23rd or 25th June, when the weather was hot and dry, the percentage kill ranged from 96 to 99·2. Percentage re-infestation (calculated on infestation before treatment) 3 to 4 days after treatment ranged from 0·7 to 16, and 6 days after treatment, in the four plots that had not been harvested, from 2·1 to 6·3. Large proportions of these Aphids were very young nymphs. From 22nd to 28th June, the population on a control plot nearly doubled. The toxic action of the nicotine vaporiser appears to be similar to that of spot-fumigation in the greenhouse.

Richardson (H. H.) & Busbey (R. L.). **Laboratory Apparatus for Fumigation with low Concentrations of Nicotine, with Studies on Aphids.**—*J. econ. Ent.* **30** no. 4 pp. 576–582, 3 figs., 6 refs. Menasha, Wis., August 1937.

The following is part of the authors' summary: A laboratory apparatus is described in which air flows varying in nicotine concentration from 42 to 0·25 parts per million have been obtained, thereby making possible toxicity studies with Aphids. Still lower concentrations may evidently be obtained if desired. Concentrations of 1 part nicotine per million parts air killed large numbers of *Myzus persicae*, Sulz., from nasturtium, which was used in most of the tests. *Aphis rumicis*, L., from nasturtium was somewhat less resistant than *M. persicae*, whereas *M. onobrychis*, Boy. (*Illinoia pisi*, Kalt.) from pea was more resistant.

Ginsburg (J. M.). **Effect of different Soaps on Formation of Soluble Arsenic from Lead Arsenate in soft and hard Waters.**—*J. econ. Ent.* **30** no. 4 pp. 583–590, 5 refs. Menasha, Wis., August 1937.

The following is the author's summary: Experiments were conducted with lead arsenate mixed with soluble and insoluble soaps in soft and in hard water for the purpose of determining to what extent soaps may safely be used as spreaders and correctives with arsenical sprays. The following results were obtained. Water-soluble soaps increase the soluble arsenic in soft water in proportion to the amount of soap added. Hard waters form large amounts of soluble arsenic, especially when the hardness is due to carbonates or bicarbonates. Soluble soaps, added to hard water, prevent the formation of excessive amounts of soluble arsenic. Soluble soaps react with the salts present in hard water, precipitating the corresponding insoluble soaps, which apparently do not affect the lead arsenate. Certain insoluble metallic soaps when added directly to the lead arsenate also prevent formation of water-soluble arsenic in hard water. Of the various salts causing water hardness, the bicarbonates and carbonates are primarily responsible

for the production of soluble arsenic from lead arsenate. While in hard water the presence of soluble soap may make lead arsenate safer on foliage, the addition of soaps to soft water may result in increased arsenical injury.

Creighton (J. T.). *Homaledra sabalella* **Chambers, the major Pest of Palms in Florida.**—*J. econ. Ent.* **30** no. 4 pp. 590–595, 2 figs. Menasha, Wis., August 1937.

In Florida, the Tineid, *Homaledra sabalella*, Chambers, infests *Serenoa serrulata*, coconut (*Cocos nucifera*), *Sabal palmetto* and *S. glabra*, ornamental palms native to the United States, and also many imported species, including *Cocos australis*, *Latania loddigesii*, *Washingtonia robusta* and five species of *Phoenix*. So far as is known, only Palmaceae are attacked. The feeding of the larvae causes dark brown blotches on the leaves, which eventually dry up and die.

The life-history was very similar under field and laboratory conditions. It is thought that the adults remain concealed among the inner fronds during the day ; pairing and oviposition undoubtedly take place at night. The average length of adult life at laboratory temperature was 3·6 days, but fertilised females may live for 20 days and lay 2 batches of eggs. The period between emergence and oviposition varies from 0 to 10 days, the average for the groups observed being 3·1. The eggs are deposited, usually in batches of 12–73, but sometimes singly, on the undersurface of the husk that surrounds the young leaflets. In the laboratory, the egg stage lasted from 9 days in summer and early autumn to 25 days in January, and in the field from 12 to 47 days. When the larvae are ready to hatch, each cuts a circular hole in the bottom of the egg-shell and begins feeding immediately below the egg-mass, retaining the protection of the egg-shell. The larvae then spin a protective web of silk under which they feed in colonies of 35–100. The web is extended as the feeding larvae proceed up the leaf. The upper and lower surfaces of the leaves and, in extreme cases, the upper surface of the leaf stems are subject to attack. The average lengths of the six larval instars for 51 individuals were 12·66, 8·43, 8·59, 6·78, 5·72 and 11·54 days. The maximum and minimum durations of the larval stage were 91 and 29 days, respectively, in the late autumn and winter and in the early autumn generations. There are usually about 5 generations a year, with considerable overlapping of broods and no distinct hibernating stage. At 32·6°F., the average life of adults was 13·27 days, and the maximum life of larvae 9·15 days. Subjection to freezing delayed the development of the pupae for about the number of days that they remained at freezing temperature.

For control, infested fronds and the husks round the young leaves should be cut and burned. Lead arsenate (1½ lb. to 50 U.S. gals. water with an adhesive) kills the larvae but discolours the foliage unless some substance such as malachite green is added. Various proprietary pyrethrum sprays and oil emulsions were toxic to the larvae, but their penetrating power was generally poor. Larvae, pupae and adults of the Carabid, *Plochionus amandus*, Newm., have been found in considerable numbers in the tunnels of *H. sabalella*, and presumably exercise some control. They were not appreciably affected by sprays. Other natural enemies include ants, which prey on the prepupal and pupal stages, sometimes exterminating whole colonies, and various Hymenopterous parasites.

Section of Plant Quarantine and Inspection.—*J. econ. Ent.* **30** no. 4 pp. 597–632, 5 figs., 1 ref. Menasha, Wis., August 1937.

The papers in this section include : Accomplishments of the Bureau of Entomology and Plant Quarantine under Emergency Funds, by L. A. Strong (pp. 597–598) ; Origin and Development of the Canadian Plant Inspection Service, by W. N. Keenan (pp. 599–606), in which a historical review is given of Canadian provincial and federal legislation for the control of insect pests, including the import, export and movement within the Dominion of plants or plant products likely to be infested ; and Progress of Japanese Beetle Suppression in St. Louis, by J. C. Dawson (pp. 611–614), in which it is reported that the number of Japanese beetles [*Popillia japonica*, Newm.] trapped in 1936 was 93·5 per cent. less than in 1934. In White Grub Devastations in Iowa Nurseries (pp. 615–618), F. Andre reports that infestation by larvae of *Lachnosterna* (*Phyllophaga*) was unusually severe in 1936. Of the 34 species found, one of the most common and widespread was *L.* (*P.*) *implicita*, Horn, which destroyed 6 million out of 13 million seedlings and cuttings in a single nursery. The principal damage in 1936 was caused by brood C, the larvae of which were in their third year, but grubs of the other two broods were also found. The average number of brood C grubs per acre, according to samples examined, varied from 23,000 among wild grapes to 169,000 among poplar cuttings. The larvae injured cuttings by chewing through the cambium and into the woody portions, and seedlings by cutting off the tap-root 2–5 ins. below the surface of the soil. Strawberries suffered severe injury, 80 per cent. of the plants in one nursery being destroyed.

The present outbreak of grasshoppers in Iowa, which began in 1931, is reviewed by C. J. Drake and G. C. Decker in The Grasshopper Situation in Iowa (pp. 618–621). Warm, dry weather in the spring of 1936 caused the eggs to hatch early and was favourable to the young hoppers. *Melanoplus mexicanus*, Sauss., and *M. bivittatus*, Say, began to hatch in April, and adults appeared, respectively, in late May and June. The hoppers of *M. femur-rubrum*, DeG., and *M. differentialis*, Thomas, did not appear in great numbers until June. Eggs of *M. mexicanus* deposited early in the season began to hatch in August and September. Young hoppers appeared about the middle of August, and second- and third-instar hoppers were fairly common by mid-September. Some second-generation females were observed laying eggs in late October. Cage experiments proved that hoppers appearing in the autumn belonged to a second generation. *Ageneotettix deorum*, Scudd., *Orphulella speciosa*, Scudd., and other prairie species practically destroyed thousands of acres of bluegrass [*Poa*] pasture in western Iowa, and there was a decline in the numbers of their eggs in the most heavily infested districts. Several other species increased considerably. Where bait was available in sufficient quantities from hatching time till large migrations began, control was successful, but in most counties sufficient bait was not available. About 4,463 tons were used, but 2–3 times as much could have been utilised to advantage. In the autumn of 1936, there were more grasshopper eggs in the soil than at any other time during the last 40 years.

In The Vetch Bruchid, *Bruchus brachialis* Fåhraeus (pp. 621–632), J. S. Pinckney gives the distribution of this European beetle in the United States [*R.A.E.*, A **25** 36, 556, etc.] and a list of food-plants, all of which are vetches (*Vicia* spp.). All stages are described. In

North Carolina, the overwintered adults appear about mid-April, 7–10 days before the vetches begin to bloom. Pairing takes place in the spring only. Eggs are deposited singly ; 42 have been found on one pod, but the usual number is 10. The peak of oviposition is reached at the end of May, and all the overwintered adults have disappeared by the third week in June. Of 70 eggs under observation, 75·7 per cent. hatched, in an average of 8 days. The larvae gnaw through the chorion of the egg and the valve of the pod, and 90 per cent. enter the seed through the hilum or near it. If more than one larva enters a seed, the stronger destroys the weaker. There are 4 larval instars, lasting altogether about a fortnight. When the vetch is cut, there are larvae of all stages in it. Pupation begins about 15th June, and the new adults emerge from late June to early August. It is not known where they hibernate. The adult stage lasts 10–12 months. In addition to three of the parasites recorded in 1933 [**21** 414], the author has reared *Lariophagus distinguendus*, Först., and *Sphaerakis* (*Bruchobius*) *mayri*, Masi, from *Bruchus brachialis*. This is the first time the latter has been found in the United States. Suggestions are made for controlling the spread of the Bruchid by delaying threshing and cleaning, sacking and shipment of seed so that all adults may first leave it, and refraining from moving vetch day when live adults may be in the pods. For early shipments, fumigation is recommended. Experiments have shown that all the Bruchids can be killed by the following exposures : 7 oz. liquid hydrocyanic acid per 100 cu. ft. space and 1,500 lb. seed in a partial vacuum of 28 ins. for 2 hours at 80–90°F. ; 3 lb. (volatilised and introduced into the chamber as a gas) per 1,000 cu. ft. and 15,000 lb. seed for 24 hours at atmospheric pressure and 75°F. ; or 20 lb. carbon bisulphide per 1,000 cu. ft. for 24 hours at atmospheric pressure and 80°F. Lists are given of the countries from which this Bruchid has been recorded, those from which vetch seed is chiefly imported into the United States, and those from which dead adults were intercepted between May 1926 and September 1935. No living Bruchids were found during that time, but of 49 commercial shipments examined under the altered quarantine regulation [**24** 803] before 2nd December 1936, 11 were infested with living Bruchids.

MARKWOOD (L. N.). **Semicommercial Manufacture of Nicotine Peat.**—*J. econ. Ent.* **30** no. 4 pp. 648–651, 3 refs. Menasha, Wis., August 1937.

The following is the author's summary of this paper on the preparation of nicotine peat without separating the soluble from the insoluble reaction product [*R.A.E.*, A **24** 778], a method that considerably reduces the cost of manufacture : The semi-commercial manufacture of nicotine peat from New Jersey reed peat and German moss peat is described. New Jersey peat is screened for the removal of impurities, dried to a moisture content of 10 per cent., soaked in 2 per cent. hydrochloric acid, washed free of soluble matter, and then treated with nicotine in the presence of water. The mixture is dried and ground to a fine powder. German moss peat is treated directly with nicotine. Analyses of the two products are given. The nicotine content is about 10 per cent. and the nicotine insolubility is 88 per cent. of the total for the New Jersey product and 68 per cent. for the German product. Standard commercial equipment, including a vacuum dryer and a centrifuge, was used.

Hartzell (F. Z.) & Moore (J. B.). **Control of Oyster-shell Scale on Apple by means of Tar Oils, Tar-lubricating Oils, and lubricating Oils containing Dinitro-o-cyclohexylphenol.**—*J. econ. Ent.* **30** no. 4 pp. 651–655, 1 ref. Menasha, Wis., August 1937.

Tests with various oils against the apple form of the oyster-shell scale, *Lepidosaphes ulmi*, L., were made in 1936 on apple in western New York. Each tree was sprayed once on 9th or 10th April. Counts were made on representative twigs after all the eggs had hatched and first-stage scales had been produced. On control trees, the ratio of young scales to old was 8·2185. Mixtures of lubricating oil and dinitro-o-cyclohexylphenol of three kinds containing, respectively, 75, 81 and 96 per cent. oil, 3, 4 and 4 per cent. dinitro-o-cyclohexylphenol and 22, 15 and 0 per cent. emulsifier were tested at concentrations giving 3, 4 and 6, 4 and 5, and 4 and 5 per cent. oil in the spray. All these sprays except that containing 3 per cent. oil reduced the ratio of young scales to old to 0·1 or less, as did also a spray containing 4·5 per cent. coal-tar oil and 1 per cent. lubricating oil. The weakest dinitro-o-cyclohexylphenol and oil spray and 4·5 and 5·5 per cent. coal-tar oil reduced it to between 0·1 and 0·17. Water-gas tar oil at 4·5 and 5·5 per cent. gave very poor control, but the weaker concentration was much improved by the addition of 1 per cent. lubricating oil. Extar, a proprietary emulsion, at a strength to give 2·4 per cent. oil in the spray was only moderately effective, but also controlled the San José scale [*Aonidiella perniciosa*, Comst.]. Dinitro-o-cyclohexylphenol must be applied before the buds reach the silver-tip stage.

Dobroscky (I. D.). **Orchard Experiments with Natural Cryolite for Codling Moth Control.**—*J. econ. Ent.* **30** no. 4 pp. 656-658. Menasha, Wis., August 1937.

To test the effectiveness of natural cryolite against the codling moth [*Cydia pomonella*, L.], 10 apple trees in an orchard in eastern New York that had not been sprayed for 15 years were treated with a combination of 4 lb. natural cryolite, 6 lb. wettable sulphur or Kolofog [bentonite-sulphur] and 1 lb. Goulac [sulphite lye] to 100 U.S. gals. water, 6 times between 2nd May and 30th June. Only 2 trees bore enough fruit to count, and the yield of these was compared with that of 3 unsprayed trees of the same variety. On sprayed and unsprayed fruit, respectively, there were 4·43 and 50·7 per cent. stings and 14·22 and 43 per cent. entries. No spray injury was caused by natural cryolite, though spraying was done at 100°F. or over.

In an adjoining well-kept orchard, 10 trees received 4 sprays of lead arsenate with lime-sulphur at the beginning of the season and 2 of natural cryolite with Kolofog on 9th and 30th June. The peak of hatching was about 12th June. With the exception of 2 unsprayed controls, the other trees in the orchard were given 5 sprays of lead arsenate and 1 of calcium arsenate. There was considerable difference in susceptibility to codling moth injury between the three varieties of apple involved. Lead arsenate and natural cryolite gave better control than lead and calcium arsenates on two varieties and only slightly less good on the third. Apples that had received the 6 sprays of natural cryolite with Goulac had a fluorine residue of 0·05 grain per lb. Fruit of another variety, sprayed 4 times with lead arsenate and twice with natural cryolite, had 0·001 grain arsenic trioxide and 0·01 grain fluorine per lb.

Frost (S. W.). **Tests with Summer-oil Emulsions on Peach.**—*J. econ. Ent.* **30** no. 4 pp. 658–663, 1 fig., 1 ref. Menasha, Wis., August 1937.

Eight commercial sulphurs were tested in Pennsylvania on peach in combination with various proprietary oils and soaps [*cf. R.A.E.*, A **24** 532]. The sprays were applied in May, June and July; the injury they caused was more severe in May than in June and negligible in July. The trees were susceptible to injury, as they had been weakened by extreme weather during the winter. As summer-oil emulsions are normally applied for the control of the red spider [*Paratetranychus pilosus*, C. & F.] in July or August, the severe injury would not occur. Tests indicated that 1 per cent. actual soap or oil emulsion gave satisfactory kill of larvae of *Lecanium nigrofasciatum*, Perg. This would give additional value to a contact spray applied in summer against the red spider.

Brindley (T. A.) & Hinman (F. G.). **Effect of Growth of Pea Weevil on Weight and Germination of Seed Peas.**—*J. econ. Ent.* **30** no. 4 pp. 664–670, 6 figs., 8 refs. Menasha, Wis., August 1937.

Experiments were made in 1933–35 on the effect of infestation by *Bruchus pisorum*, L., on the germinating powers of two varieties of peas, one in Idaho and the other in Oregon. The samples of peas were fumigated with carbon bisulphide as soon as they were picked. During the first two years there was a distinct correlation between germination and larval development. In Idaho, of infested peas picked on 27th July 1933, when all larvae were in the first instar, 98 per cent. germinated. The percentage of germination decreased rapidly in peas picked at successively later dates. In 1934, practically no peas picked on 20th July sprouted, but 45 per cent. of those picked on 26th germinated, and the percentage then decreased with each successive picking. The failure of the first batch to germinate was attributed to the effect of fumigation before the seeds were ripe, as only 68·5 per cent. of the sound peas sprouted, as against an average of 93·8 per cent. of peas picked on later dates. Of infested peas picked on 30th June 1934 in Oregon, 91 per cent. produced strong sprouts. The percentage germination decreased until, on 28th July, only 1·5 per cent. produced strong sprouts. In 1935, there was no apparent correlation between germination and Bruchid development. Loss of weight was closely correlated with the development of the Bruchid. In 1933, the weight of unfumigated infested peas decreased by 22·4 per cent. in 42 days, while that of sound peas of the same batch decreased by only 1·1 per cent. In experiments in 1935, the maximum losses in weight of unfumigated infested material and fumigated controls were 16·4 and 4·4 per cent., and the minimum losses 14·4 and 2·2 per cent., respectively.

Mail (G. A.). *Blapstinus substriatus* **Champion, a sporadic Wheat Pest in Montana.**—*J. econ. Ent.* **30** no. 4 pp. 670–675, 1 fig., 6 refs. Menasha, Wis., August 1937.

During the spring of 1931, crops in various parts of Montana were attacked by adults of the Tenebrionid, *Blapstinus substriatus*, Champ. [*R.A.E.*, A **21** 229], of which E. A. Chapin has found *B. gregalis*, Casey, to be a synonym. Several fields of winter wheat were almost

destroyed, and many of them had to be resown with spring wheat, which on 22nd May was also being severely damaged. Injury to flax to the extent of 50 per cent. was reported. Shoots of spring wheat were nipped off at or below the soil surface, and leaf blades of young plants frequently had 10–12 beetles nibbling them. Blades were often dragged into the soil and eaten there. Several sickly plants had a small puncture about a quarter of an inch above the kernel.

This Tenebrionid appears to develop best under drought conditions. In Teton county, the beetles were most abundant at the end of May before the spring rains, and relatively scarce by 26th June. Heavy rain fell on 12th July, and dead beetles were numerous 4 days later under stones and clods, while live ones had practically disappeared. The subsequent hot, dry weather stimulated the surviving beetles to great activity. At the end of the season a variety of weeds were fed on in preference to mature wheat. After a larva of *Blapstinus* sp. had been found on 17th August on a golf course where a few adults of *B. substriatus* had been present all the summer, larvae were sought in fields heavily infested earlier in the season, but very few were found, though new-generation adults were plentiful, there being hundreds under every Russian thistle [*Salsola*]. The few larvae and many adults were in the first 4 ins. of soil. On 26th August, beetles were found in great numbers in a semi-arid region in the south-west in plant débris under *Chrysothamnus* and *Artemisia* and under dried cattle and horse droppings and old fence posts. On 3rd September, they were not so plentiful, but numbers were found under Russian thistle, apparently feeding on the sap. On 16th October, beetles were present in the fields in smaller numbers than before under Russian thistle and were active when disturbed. On 11th May 1932, no beetles were found in spring wheat where the soil was moist, and only a few in drier surroundings. On 23rd May, in the semi-arid region, the beetles were still bunched up, 25 to 30 in about 3 cu. ins. of loose material, 2 to 3 ins. below the surface. On 15th June, after localised showers, only 20 were found in 4 hours. In the drier areas, each plant of *Chrysothamnus* yielded 20–50.

In the laboratory, batches of adults from Teton county, isolated on 19th June 1931, were kept at room temperature in cans in damp soil, dry soil or slightly moistened blotting paper, and fed on foliage of potato, lucerne, kale, *Tradescantia*, beet and cereals. Eggs were first observed on 19th July, and, within a few days, larvae were numerous. Beetles from the south-west, collected and isolated on 15th June, began to oviposit on 23rd. More eggs were produced and the beetles lived longer in the dry soil than in the wet soil or blotting paper. Under damp conditions, 75 per cent. died in 2 weeks, whereas in dry soil, none died. Egg-laying continued to the end of July. When honey syrup was given as food, the beetles lived longer in damp soil than dry, but no eggs were produced. The egg stage lasted 3–6 days, and the larval and pupal stages averaged 41·8 and 8 days. The larvae were fed on rootlets of the various food-plants. The younger larvae required moist soil to develop. In constant temperature experiments, all beetles died in 2 days at 45°C. [113°F.], and first-instar larvae survived for 5 days. At 35°C. [95°F.], the beetles thrived on dry soil and laid numerous eggs, which hatched within 3 days, but died on damp soil in a short time without ovipositing. At 25°C. [77°F.] on dry soil, the beetles fed well and laid several eggs which hatched in 8 days. At 15°C. [59°F.], they fed occasionally and lived

for 6 weeks, but did not oviposit. At 8°C. [46·4°F.], they did not feed but none died in 5 weeks. Adults collected in late autumn and placed in cages sunk into the ground under débris did not survive the winter. The temperature was well above that which they must experience in nature.

In field trials, *B. substriatus* was successfully controlled by bran baits poisoned with white arsenic. The addition of amyl acetate, salt or molasses did not increase their effectiveness. Only a few dead beetles were observed after 15 hours, but about 40 and 80 per cent. had died after 40 and 60 hours.

List (G. M.). **Possible Migration of Diamondback Moth.**—*J. econ. Ent.* **30** no. 4 p. 676. Menasha, Wis., August 1937.

Plutella maculipennis, Curt., was very numerous in north-eastern Colorado during early and mid-May 1937, although the number of larvae on cabbage and cauliflower in the late summer and autumn of 1936 was below normal and no infestation of wild food-plants was noticed. The first moths of the heavy infestation were observed on 27th April when a wind that changed its direction brought with it heavy clouds of dust originating in extreme south-eastern Colorado and northern New Mexico.

Holst (E. C.). **Aseptic Rearing of Bark Beetles.**—*J. econ. Ent.* **30** no. 4 pp. 676–677, 2 refs. Menasha, Wis., August 1937.

During the summers of 1934 and 1936, *Dendroctonus frontalis*, Zimm., *Ips grandicollis*, Eichh., and *I. calligraphus*, Germ., were reared from egg to adult under aseptic conditions by a method that is described in detail. From 8, 71 and 6 newly hatched larvae of the three beetles 1, 10 and 2 adults, respectively, were obtained. Most of the failures appeared to be due to excessive dryness of the pieces of phloem in which the larvae were kept, and several to the larvae escaping; 2 adults became mouldy and so could not be considered aseptic. All the beetles were active and within the limits of size recorded for the species. It thus appears that neither the yeasts nor the blue-stain fungi that are commonly associated with these bark-beetles in pines are essential for their development [*cf. R.A.E.*, A **19** 179, etc.].

Bottimer (L. J.). *Diabrotica connexa* **Lec. transported in Vegetables.**—*J. econ. Ent.* **30** no. 4 p. 677. Menasha, Wis., August 1937.

In February 1937, a live adult of *Diabrotica connexa*, Lec., which is known apparently only from Mexico and southern Texas, was found in a house in New Jersey, having presumably been transported in a consignment of vegetables from southern Texas.

Ingram (J. W.). **New Pest of Sugar Cane in continental United States.**—*J. econ. Ent.* **30** no. 4 pp. 677–678. Menasha, Wis., August 1937.

Infestation of sugar-cane by *Tarsonemus bancrofti*, Mich., which had not previously been recorded from the United States, was observed over an area of about 600 sq. ft. in Louisiana in October 1935 and in two plantations in Florida in January and September 1936. The young

mites are usually found between the leaf-sheath and the stem, the older ones embedded in the rind, on the cane bud and on the leaf-sheaths.

JONES (S. C.). **Lime Sulfur to control Forest Tent Caterpillar.**—*J. econ. Ent.* **30** no. 4 p. 678. Menasha, Wis., August 1937.

Observations in Oregon in 1937 on plots of prunes sprayed 1 to 3 times against *Taeniothrips inconsequens*, Uzel, with 3 gals. lime-sulphur and 1 pt. nicotine sulphate in 100 gals. water confirmed reports that lime-sulphur destroys *Malacosoma disstria*, Hb. One application gave excellent control. Apparently the eggs hatch, but the young larvae do not develop and soon die. They were not controlled on trees sprayed with 2 per cent. oil emulsion and nicotine.

DONOHOE (H. C.). **Recovery of Larvae paralyzed by *Microbracon hebetor* Say.**—*J. econ. Ent.* **30** no. 4 pp. 678–679. Menasha, Wis., August 1937.

During the winter of 1935–36, life-history studies of *Microbracon hebetor*, Say, were carried out in California at temperatures of 80 and 90°F. with full-grown larvae of *Ephestia figulilella*, Gregson, as hosts. The adult parasites, either as mated pairs or isolated unfertilised females, were provided at intervals of 24 hours with larger numbers of active larvae than they could paralyse. The larvae paralysed each day by each female were removed and kept in separate containers. Paralysed larvae frequently recovered, revival generally taking several days. Parasites frequently emerged in the containers and again paralysed larvae that were slowly recovering. Of larvae kept at 90 and 80°F., 14 and 17·5 per cent., respectively, recovered. In experiments at 80°F., 11·9, 28·5 and 29·3 per cent., respectively, of the larvae parasitised during the first, second and third 15 days of the Braconid's adult life recovered. Metamorphosis of recovered larvae was normal.

JONES (H. A.) & SULLIVAN (W. N.). **Chemical and insecticidal Tests of Samples of *Tephrosia toxicaria*.**—*J. econ. Ent.* **30** no. 4 pp. 679–680, 5 refs. Menasha, Wis., August 1937.

In experiments made in September 1934, acetone extracts of samples of roots of *Tephrosia toxicaria* from Venezuela and seeds from El Salvador were prepared, subjected to the modified Durham colour test [*R.A.E.*, A **21** 271] for rotenone plus deguelin, and tested for insecticidal action on house-flies. The colour test indicated the presence of 1 per cent. rotenone plus deguelin in one sample of roots, 0·5 in the three others and 2 per cent. in the seeds, and the results of the toxicity test agreed approximately with these figures.

A small amount of crystalline material separated from one sample was shown to be rotenone. The isolation of rotenone from *T. toxicaria* has not hitherto been reported.

DONOHOE (H. C.). **Indian-meal Moth in California.**—*J. econ. Ent.* **30** no. 4 pp. 680–681, 1 ref. Menasha, Wis., August 1937.

Records have been made of the occurrence in California of *Plodia interpunctella*, Hb., in drying or waste fruit in the field [*cf. R.A.E.*, A

23 19]. Fallen figs were occasionally attacked, but were in all cases more infested by *Ephestia figulilella*, Gregson. *P. interpunctella* was, however, numerous in figs kept in temporary storage. It has been recorded in the field in drying and dried raisins and waste fruits and fruit refuse, including mulberries, cherries, dates and apricot and peach stones. It attacks dried prunes, peaches, apricots and nectarines in storage. Raisins in trays in the vineyard were rarely found to be infested before 1934, when 7·6 per cent. of the samples examined were slightly infested. In 1935, 35·4 per cent. were infested, some slightly and some severely, the maximum infestation being 24,800 larvae per ton. Different kinds of raisins vary in susceptibility. Investigation failed to yield evidence that the species overwinters in the field except in unprotected boxes of apricot stones, where many larvae were found in February 1931. Larvae of various instars overwinter in open-sided raisin storage sheds, and full-grown larvae in cracks in storage boxes and beneath timbers, etc., near the surface of the soil.

Webb, jr. (J. E.). **Parasitism of Codling Moth Larvae of native Parasites at Cornelia, Ga., in 1936.**—*J. econ. Ent.* **30** no. 4 p. 681. Menasha, Wis., August 1937.

Parasitism of the first and second broods of the codling moth [*Cydia pomonella*, L.] in northern Georgia in 1936 amounted to 40·8 and 22·2 per cent. in an unsprayed orchard and 21·7 and 12·8 per cent. in a sprayed orchard. Of all the larvae under observation during the season, the percentages parasitised by *Ascogaster carpocapsae*, Vier., *Pristomeridia* (*Pristomerus*) *agilis*, Cress., and *Phanerotoma tibialis*, Hald., were 21·3, 2·7 and 1·4. From 37 per cent. of the larvae considered as parasitised by *A. carpocapsae*, hyperparasites of the genus *Perilampus* were reared.

Fassig (W. W.) & Campbell (F. L.). **Relative Effectiveness of Homologs of Paris Green against Confused Flour Beetle.**—*J. econ. Ent.* **30** no. 4 pp. 681–682, 5 refs. Menasha, Wis., August 1937.

The toxicities of homologues of Paris green [*cf. R.A.E.*, A **25** 431, etc.] were compared by confining about 20 adults of *Tribolium confusum*, Duv., with mixtures of 0·2 gm. insecticide in 1·8 gm. wheat flour for 24 hours at 27°C. [80·6°F.] and 50 per cent. relative humidity. Lead arsenate was used as a standard for comparison. No beetles died on the untreated controls. The mean percentage mortalities obtained with copper stearoarsenite, soybean oil green, linseed oil green, fish oil green, copper oleoarsenite and lead arsenate were 88, 84, 83, 56, 27 and 7. In tests under similar conditions, copper crotonoarsenite, copper lauroarsenite, ground-nut (peanut) oil green, copper monochloracetoarsenite, copper dichloracetoarsenite, copper acetoarsenite (Paris green) and lead arsenate gave mean mortalities of 98, 92, 91, 64, 62, 51 and 11 per cent., respectively.

López Cristóbal (U.). **Los aphidos de los cereales.**—pp. 11–22, text ill. La Plata, Minist. Obras publ. prov. B. Aires, 1937.

Toxoptera graminum, Rond., which was observed on wheat in La Plata in 1937, may develop into a serious pest of cereals unless

suitable measures are adopted [*cf. R.A.E.*, A **25** 631]. Two other cereal Aphids found in La Plata in 1937 and not previously recorded in Argentina were *Macrosiphum avenae*, F. (*granarium*, Kby.), which occurred in small numbers in association with *T. graminum*, chiefly attacking the ears, and *Rhopalosiphum prunifoliae*, Fitch (*Siphocoryne avenae*, auct.), which was more numerous than *M. avenae*, but only one-tenth as abundant as *T. graminum*. The value of the Braconid, *Aphidius platensis*, Brèthes, in the control of *Toxoptera* [*loc. cit.*] was found to be reduced by the fact that it is itself parasitised by a Cynipid, *Xystus* sp., probably undescribed.

CORBETT (G. H.), YUSOPE (M.) & HASSAN (A.). **Insects associated with Copra in Malaya.**—*Sci. Ser. Dep. Agric. S.S. & F.M.S.* no. 20 pp. 1–91, 9 pls., 28 refs. Kuala Lumpur, 1937. Price *Cts.* 50.

This paper contains a list of 26 insects and a mite that have been found on copra in Malaya [*cf. R.A.E.*, A **21** 676, etc.] and an account of the bionomics of some of the more abundant species, including experiments on the duration of their development in copra, with and without moulds or bacterial slime, and the attraction of different types of copra for them.

The following is largely taken from the authors' survey of their observations: *Carpophilus dimidiatus*, F., *Necrobia rufipes*, DeG., and *Ahasverus advena*, Waltl, are the commonest insects associated with copra in Malaya, but of these only *A. advena* has been found associated with stored rice. *C. dimidiatus* is the commonest insect near copra kilns, and is attracted to coconut meat as soon as the moulds, upon which it feeds, begin to develop. There is a high mortality among larvae kept on good copra. *N. rufipes* generally occurs in stores at ports, especially in wet weather. The eggs are laid freely on degenerated, mouldy copra. There is a high mortality among larvae on good copra and their maturation period is considerably extended. Both larvae and adults will, however, feed on good copra, although they much prefer it when soft and degenerated. It is thought that the beetles are not attracted by the moulds of degenerated copra, or coconut oil or its fatty acids, but by the decomposition products produced by moulds [*cf.* **23** 440]. It is possible that the beetles, which are predacious, associate these products with the presence of *Carpophilus* and other larvae, as, under controlled conditions, they frequently left degenerated copra to feed upon their own larvae as well as on *Carpophilus*. *Ahasverus advena* has not been found near copra kilns, but is often common in stores on estates and at ports. It is almost entirely mycetophagous, and has rarely been recorded on copra without moulds. These three pests would, therefore, be considerably reduced in number if good quality copra were prepared.

Other insects recorded on copra included *Tenebroides mauritanicus*, L., *Oryzaephilus surinamensis*, L., *Tribolium castaneum*, Hbst., *Corcyra cephalonica*, Stn., and *Doloessa viridis*, L., all of which are associated with rice. Sacks that have been used for rice are generally used for the transport of copra, and are considered the most important source of the infestation of it by insects attacking both products [*cf.* **19** 646]. While fumigation with carbon bisulphide (4 lb. per 1,000 cubic ft. for at least 24 hours) or subjection to a dry heat of 176°F. will prove effective in killing the insects within the sacks,

neither of these measures is so convenient as the immersion of the sacks in boiling water for two minutes.

All the insects enumerated above also occur in the accumulation of débris and dust in cracks and under the flooring of stores, and several other insects common in such rubbish have occasionally been recorded on copra. Rubbish accumulations should therefore be burned and stores should be kept clean.

WATSON (M. A.). **Field Experiments on the Control of Aphis-transmitted Virus Diseases of** *Hyoscyamus niger*.—*Ann. appl. Biol.* **24** no. 3 pp. 557–573, 2 figs., 4 refs. Cambridge, August 1937.

The following is the author's summary of experiments in England on the control of the virus diseases of *Hyoscyamus niger* transmitted by the Aphid, *Myzus persicae*, Sulz. [*cf. R.A.E.*, A **21** 2]: Aphis infestation of the first-year's growth of *Hyoscyamus niger* grown as a biennial crop was reduced by spraying with a solution of nicotine and soft soap for the first 8 or 9 weeks. The greatest effect was obtained by spraying at weekly intervals, but spraying fortnightly and spraying weekly in June or weekly in July also slightly reduced the infestation. The percentage of infection by aphis-transmitted viruses was lower on the sprayed plots than on the unsprayed. No effect of treatments on yield was obtained at the first cropping in the first year of growth which coincided with the end of the spraying period. As a result of weekly spraying in the first year, a 30 per cent. increase of yield was obtained in the third crop taken in May of the second year.

BARNES (H. F.). **The Asparagus Miner** (*Melanagromyza simplex* **H. Loew**) (**Agromyzidae ; Diptera**).—*Ann. appl. Biol.* **24** no. 3 pp. 574–588, 2 pls., 22 refs. Cambridge, August 1937.

This account of the bionomics of *Agromyza* (*Melanagromyza*) *simplex*, Lw., infesting asparagus in England [*cf. R.A.E.*, A **22** 542] is based mainly on field observations in Hertfordshire, supported by a few breeding experiments in the insectary. All stages of the fly are described, and records are given of its local distribution in England and of the other countries [**23** 85] in which it occurs.

From puparia collected in September 1933, placed on sand and kept at room temperature, flies emerged at intervals from 23rd December to 1st August 1934. From those collected at the same time and kept in an outdoor unheated insectary, the flies emerged from 9th June to 16th July 1934. From material collected on 2nd July, flies emerged from 24th August to 2nd September. In 1934 and 1935, adults of the overwintered generation were seen in the field from 4th June to 28th July, and 9th June to 30th July, with maximum numbers on 10th and 29th June, respectively. Pairing was observed 5 and 13 days after emergence, and usually occurred during the morning. A day or so later the eggs are inserted just beneath the epidermis of the flowering and shooting stalks or, more rarely, of the cutting stems just above or below the soil surface. The larvae mine up the stalk in a zigzag fashion, sometimes to a height of 12 ins., but turn down again to pupate, though puparia may occur at any height above the ground. In 1934, larvae were first found on 28th June, 17 days after oviposition was first observed, and puparia on 7th July. Many of the first-generation puparia overwinter, but some produce adults that are on the wing in August and September and give rise

to a second generation. The life-history of this generation was similar to that of the first, but the puparia were generally found in the stems at or beneath ground level.

The flies are extremely active when the sun is shining, but remain motionless for a long time during cold, sunless intervals. At night, they rest among the leaves on the flowering stalks. They lived for 7–9 days indoors when fed on a sugar solution. In mature asparagus beds, the larvae did little damage unless very numerous. Infested stems, however, attract *Lonchaea flavidipennis*, Zett., which does serious damage.

During further observations on the parasites [*cf.* **22** 542], it was found that they could be induced to emerge indoors during the winter. From the batch of overwintered puparia kept in the outdoor insectary, 25 adults of *A. simplex* emerged from 9th June to 16th July, 21 of *Dacnusa* (?) *bathyzona*, Marsh., from 3rd June to 15th July, 8 of *Pleurotropis metallica*, Nees (*epigonus*, Wlk.) from 23rd May to 15th June, and 1 of an unidentified parasite on 12th September. From the material collected on 2nd July 1934, 5 adults of *M. simplex* emerged from 24th August to 2nd September, 6 of *Dacnusa* from 24th August to 8th September, and 7 unidentified parasites from 25th August to 2nd September. *Dacnusa* does not always emerge from the first-generation puparia in the same year, and it is thought that delayed emergence may be normal. In 1934, it was seen in the field on 14 days between 7th June and 8th July.

Measures that have been recommended by other workers for the control of the Agromyzid are briefly reviewed.

BARNES (H. F.). **The Hollyhock Seed Moth** (*Platyedra malvella* **Hübn.**), **together with Notes on the Distribution of** *Apion radiolus* **Kirby and an associated** *Clinodiplosis* **Species.**—*Ann. appl. Biol.* **24** no. 3 pp. 589–599, 1 pl., 1 fig., 6 refs. Cambridge, August 1937.

The following is substantially the author's summary: A survey has been made of the distribution of *Platyedra malvella*, Hb., in Great Britain and it has been found that the larvae are restricted on hollyhock (*Althaea rosea*) to the south-eastern counties of England. *Apion radiolus*, Kby., and a Cecidomyiid of the genus *Clinodiplosis*, which are also found in the seed-heads of hollyhock, are generally distributed throughout England; the Cecidomyiid also occurs in Wales and Ireland. The life-cycle of *P. malvella* is described. There is only one generation a year. The moths are on the wing from late June until early August. The larvae feed on the seeds of hollyhock, perforating the seeds characteristically. When full-grown, from mid-August onwards, they descend to the soil, where they spend the winter in cocoons. In May they become active and tunnel through the soil. They spin up again towards the end of May and in June for pupation. Infestation of hollyhock seed-heads from many localities averaged 65 per cent. in both 1934 and 1935; details are shown in a table. Small numbers of an Ichneumonid, *Angitia rufipes*, Grav., were reared from larvae of *P. malvella* collected in Essex and Hertfordshire. The literature on the food-plants and economic importance of the moth is briefly reviewed [*R.A.E.*, A **9** 277; **12** 357; **15** 512; **18** 333; **22** 486].

FISHER (R. C.). **Studies of the Biology of the Death-Watch Beetle, *Xestobium rufovillosum* De G. I. A Summary of past Work and a brief Account of the developmental Stages.**—*Ann. appl. Biol.* **24** no. 3 pp. 600–613, 5 figs., 37 refs. Cambridge, August 1937.

The following is substantially the author's summary: This paper is intended to form an introduction to a short series on studies of the biology of the death-watch beetle, *Xestobium rufovillosum*, DeG. [*cf. R.A.E.*, A **25** 494]. Its status as a pest of structural timbers in England is discussed, and the literature and past work on its life-history and habits are reviewed. General descriptions are given of the egg, larva, pupa and adult, with a short account of external sex characters in the pupa. Special attention is devoted to the morphology of the reproductive organs and to their state of development at the time of emergence of the adult. A brief account of the alimentary canal is included.

JACOBS (S. E.) & RAICHOUDHURY (D. P.). **Some Characteristics of *Ephestia kühniella* Z. reared under aseptic Conditions.**—*Ann. appl. Biol.* **24** no. 3 pp. 632–650, 1 pl., 1 fig., 14 refs. Cambridge, August 1937.

An account is given of observations made in rearing *Ephestia kuehniella*, Zell., under aseptic conditions and of a disease, probably of physiological origin, that causes considerable mortality among the larvae in grossly overcrowded cultures under both aseptic and ordinary conditions. Cyst-like bodies that sometimes occur in the spermatophore during pairing are thought to be due to secretions from the male accessory glands.

WORSLEY (R. R. LeG.). **The Insecticidal Properties of some East African Plants. II.** *Mundulea suberosa* **Benth.**—*Ann. appl. Biol.* **23** no. 2 pp. 311–328, 6 figs., 8 refs. Cambridge, May 1936. **III.** *Mundulea suberosa* **Benth. Part 2, Chemical Constituents.**—*Op. cit.* **24** no. 3 pp. 651–658, 5 refs. August 1937. **IV.** *Mundulea suberosa* **Benth. Part 3, Variability of Samples.**—*T.c.* pp. 659–664, 1 fig., 5 refs.

These papers, which continue a series on tests in Tanganyika of the insecticidal properties of East African plants [*cf. R.A.E.*, A **23** 79], deal with *Mundulea sericea* (*suberosa*).

In the first paper, an account is given of tests of the toxicity of this plant to several insects. A 10 per cent. extract of the bark in alcohol was made according to the standard method described in a previous paper [*loc. cit.*] and diluted with 1 per cent. saponin to the required strengths. Preliminary spraying tests on *Aphis tavaresi*, Del G., showed that *Mundulea* bark from Moa, which contained 0·9 per cent. rotenone, was practically as toxic as *Derris* containing 5·4 per cent., but that samples from another locality in Tanganyika and from Zanzibar, which contained about 0·5 per cent. rotenone, were less than half as toxic. Observations were therefore continued on the bark from Moa. The difference may be due to climatic conditions during growth, or it is possible that the Moa trees belong to a distinct variety. Further spraying tests on *A. tavaresi* with extracts of air-dried samples of leaves, twigs, bark, roots and seeds showed that only the bark and the seeds were appreciably toxic.

In subsequent tests *Derris* and *Mundulea* bark having rotenone contents of 5·4 and 0·9 per cent. were used. An extract of *Mundulea* prepared by the standard method was compared with *Derris* prepared similarly, and nicotine obtained by diluting commercial nicotine sulphate to the required nicotine concentration. From 10 trials of nicotine and *Derris* and 12 of *Mundulea* against *A. tavaresi*, the concentrations sufficient to give a complete kill were found to be 0·25, 0·29 and 0·33 per cent., respectively. In similar tests against *Toxoptera aurantii*, Boy., *Mundulea* was more toxic than *Derris*; the least strengths of nicotine, *Mundulea* and *Derris* giving complete mortality were 0·06, 0·125 and 0·15 per cent. Against caterpillars (larvae of *Brithys pancratii*, Cyr.), which were dipped in the solutions one at a time for a definite period, and *Orthezia insignis*, Dougl., which was sprayed with extracts of about 2 per cent. strengths, *Mundulea* and *Derris* were equally effective but nicotine much less so. The concentrations required to give 100 per cent. mortality were 2·45, 2·45 and 4 per cent., respectively, for *Brithys*, and 2, 2 and 7·5 per cent. for *Orthezia*. Against a Psyllid that sometimes infests *Citrus* at Amani, nicotine gave better results than *Derris* and *Mundulea*; the concentrations giving 100 per cent. mortality were 0·25, 0·35, and 0·35 per cent.

In a series of dusting experiments, air-dried *Mundulea* bark, ground so that the bulk of it passed through a 100-mesh sieve, was compared with pyrethrum and *Derris* against cockroaches. Marks were allotted to the adult cockroaches treated, according to their condition after various intervals of time, and the combined results of 4 trials, each on 10 insects, were plotted against time. From the curves, it is evident that the initial action of pyrethrum was very rapid, all the insects being on their backs and unable to turn over in 20 minutes, but complete mortality only occurred after 50 hours. *Derris* and *Mundulea* dusts, although less rapid in initial action, produced complete mortality in 29 hours. Similar results were obtained when the cockroaches, after dusting, were removed to clean dishes and caused to walk through the powder. House-flies confined in glass dishes and shaken up with the powders were dead about 8 hours after treatment with pyrethrum, and 10–12 hours after *Derris* and *Mundulea*. Cockroaches were also sprayed for 2 seconds with kerosene extracts of the 3 insecticides. All extracts were equally toxic at high concentrations (10 and 5 per cent.); at 2½ per cent. pyrethrum was slightly more toxic than the others, but most of the insects affected by it recovered within 48 hours.

Extracts made with water were considerably less toxic than those made with alcohol; the best results were given by heating the powdered bark on a water bath with water, although a cold filtered extract, if used at once, was almost as effective. It was not found possible to spray the unfiltered extract. Prolonged contact of the bark with cold water appeared to destroy its toxic properties. In a preliminary test, freshly made suspensions of the finely ground bark in water were more toxic than alcoholic extracts to caterpillars dipped into the solutions; but suspensions 24 hours old were considerably less toxic.

The seeds of *Mundulea* were less toxic than the bark; to produce complete mortality of *A. tavaresi* and *B. pancratii*, 0·44 and 3·25 per cent. extracts of *Mundulea* seeds, respectively, were required. The initial effect of dusting powdered seed on cockroaches was greater

than that of *Mundulea* bark and *Derris*, but it took 48 hours to give complete mortality. As a kerosene spray the seeds had little effect ; weight for weight the seeds appeared to be 75 per cent. as toxic as the bark.

Large scale field tests have not yet been carried out, but preliminary tests were made on some pests. After the application of a spray containing 0·25 per cent. *Mundulea* bark extract and 1 per cent. saponin to Aphids on *Hibiscus*, random sampling showed that complete mortality was produced, while on unsprayed trees 95 per cent. of the Aphids were alive. The same spray was also effective against Aphids on lemon. Aphids on dahlias were controlled by a spray of 0·5 per cent. extract with 0·5 per cent. soft soap. At the experiment station, the spray is now regularly used with success at a strength of 2·5 per cent. extract with 0·5 per cent. soft soap, against *O. insignis*, which infests a number of different plants. Three applications of 1 per cent. extract with 0·5 per cent. soft soap on alternate days gave complete control of the Psyllid on *Citrus* ; the three sprays probably killed all the nymphs as they came to the active stage.

The following is based on the author's summary of the second paper : The author has introduced extraction by percolation with hot ethyl acetate, the time required being much less than with ether ; the yields of rotenone obtained from a single sample of *Mundulea* bark by the two methods were 1·2 and 1·1 per cent., respectively. A series of substances was isolated from the bark, consisting of rotenone, white crystals (m.p. 187·8 C°.), which are probably a mixture of *l*-deguelin and tephrosin, yellow crystals (m.p. 219 C°.), which are probably dehydrorotenone, glucosides, and alkaloids. When these compounds were tested on *A. tavaresi*, the only one that showed any appreciable toxicity was rotenone. The two sets of crystals having been obtained by use of alkali probably do not exist as such in the bark, but have been produced from a more toxic precursor, the existence of which must be assumed to account for the total toxicity of the sample. All attempts to isolate crystals other than rotenone without using an alkali have failed completely.

The following is largely the author's summary of results detailed in the third paper : Two types of *Mundulea sericea* (*suberosa*) exist, the bark of one being smooth and of the other corky. The differences may be botanical or due to periodic burning of the latter type. Dry weather and calciferous soils appear to favour production of rotenone and other toxic principles in the plant. No correlation exists between toxicity and the amount of ether extractable material in the plant. A fair correlation was found between toxicity and rotenone content, the toxicity being about 1·6 times as great as for pure rotenone. A correlation was found for all nine samples that had any toxic action between toxicity and content of dehydrocompounds in the bark measured according to the " optical " method [*cf.* **23** 523]. This method consists in determining the optical rotation of a benzene extract, and, from a curve for pure rotenone, reading off the amount of pure rotenone equivalent to the angle obtained ; this equivalent rotenone is called the " optical dehydrocompounds." The formula for the regression line is given. To prepare solutions of equal toxicity for the various samples of *Mundulea*, it is therefore necessary to take weights inversely proportional to their content of " optical dehydrocompounds." No correlation existed between the content of dehydrocompounds by the Takei method [*cf. loc. cit.*] and toxicity.

Worsley (R. R. LeG.). **Rotenone. Part II. Evaluation of Plants containing Rotenone.**—*J. Soc. chem. Ind.* **56** pp. 15T–23T, 9 figs., 7 refs. London, January 1937. [Recd. October 1937.]

The following is based on the author's abstract. Six samples of *Derris elliptica* (of four different types), two of *D. malaccensis*, one of *D. polyantha*, and two of *Mundulea sericea* (*suberosa*) were examined chemically and the toxicity of their extracts was tested on *Aphis tavaresi*, Del G. No correlation could be found between toxicity and ether extract or rotenone contents. When, however, the content of "optical dehydrocompounds" [see preceding paper] was calculated as a percentage of the ether extractive matter instead of as a percentage of the whole sample, a direct correlation was found. A straight regression line was obtained for probits plotted against the logarithms of the concentrations of "optical dehydrocompounds" in the ether extract. The percentage toxicity corresponding to the value of the probit for 0·1 per cent. concentrations of the sample in the spray is called the "coefficient of toxicity", and the figure obtained by dividing the percentage of the ether extract in a sample by the percentage of "optical dehydrocompounds" is called the "toxicity ratio." For each sample the "toxicity ratio" was directly proportional to the weights of each required to give equal toxic effects; twice the amount of a sample of twice the toxicity ratio is necessary to give the same kill. The toxicity ratios are relative and not absolute values, and may be used for comparing different samples one with another or against a standard. The determinations required (ether extract and optical rotation) are simple and rapid to make compared with rotenone and dehydrocompound determinations. The results are based on toxicities to *Aphis tavaresi* only; they should hold for similar insects but may not do so for oil sprays against flies, cockroaches, etc. Even in these cases, however, the correlation is likely to be better than for rotenone or ether extract contents.

Reichmuth (W.). **Die Wohnungsfischchen und ihre Bekämpfung.** [Lepismids in Houses and their Control.]—*Z. hyg. Zool. Schädl-Bekämpf.* **28** no. 7 pp. 65–71, 2 figs., 6 refs. Berlin, 1936. [Recd. October 1937.]

Brief notes are given on the bionomics and distribution of *Lepisma saccharina*, L., and *Thermobia domestica*, Pack., the two Lepismids that are pests in houses in Germany. *L. saccharina* requires a rather high degree of humidity, and *T. domestica* is favoured by heat, being most active at 32–37°C. [89·6–98·6°F.]. Rooms should be kept dry and well ventilated, all cracks and other refuges being sealed. Suggested control measures against both pests include the scattering of pyrethrum powder in places where they shelter, and the use of baits containing 1 part sodium fluosilicate and 9 parts powdered sugar or made by mixing a preparation of arsenic with honey, syrup or starch size. Exceptionally heavily infested houses should be fumigated with T-gas or sulphur dioxide.

Kemper (H.). **Beobachtungen über die Biologie der Hausgrille (*Gryllus domesticus* L.).** [Observations on the Biology of the House Cricket.]—*Z. hyg. Zool. SchädlBekämpf.* **29** no. 3 pp. 69–86, 4 figs., 2 pp. refs. Berlin, 1937.

During recent years, outbreaks of the house cricket, *Gryllulus* (*Gryllus*) *domesticus*, L., have been reported in Germany [*R.A.E.*, A

19 330 ; **20** 254] and elsewhere. Information on its biology is given from the literature and the author's own observations. He found that juicy fruit and vegetables, either raw or cooked, bread slops and soft dough products were preferred to flour and other cereal products, cooked meat and dead or living insects. Hard cereal grains, sugar and hard biscuits were invariably rejected, but not on account of their hardness, for the crickets can gnaw wood. Textiles and paper were gnawed, but not ingested or only to a slight extent. Cannibalism interfered with breeding work. Females laid 40–170 eggs (average 103·6). Pairing and oviposition are described. At room temperature, the egg stage lasted 8–12 weeks and the nymphal stage 30–33 weeks, with 9–11 moults. In 1935, batches of nymphs died as a result of heavy infestation by a mite, *Histiostoma sapromyzarum*, Dujardin. Though *G. domesticus* is favoured by warmth, males and females survived exposure for 16 hours to temperatures fluctuating between —4·5 and —8·5°C. [23·9 and 16·7°F.]. There was considerable mortality and increased cannibalism when the air had a relative humidity of 45 per cent. or less.

Koller (R.). **Die Käsefliege als Schädling in Fleischbearbeitungsräumen.** [The Cheese Fly as a Pest in Meat Factories.]—*Z. hyg. Zool. SchädlBekämpf.* **29** no. 4 pp. 104–106. Berlin, 1937.

A brief account, mainly from the literature, is given of the bionomics and control of *Piophila casei*, L. [*R.A.E.*, A **10** 397 ; **15** 324 ; **19** 507, etc.]. The flies often occur in huge swarms in meat factories, and, about 10 hours after pairing, the females lay up to 500 eggs on cured meat. At 27–32°C. [80·6–89·6°F.], the larvae hatch in 24 hours. They moult three times within 6–14 days and pupate in dark, dry places free from fat. The adults emerge 5–7 days later, pair in a few days and live for over a month. As the larvae burrow, the infestation is seldom detected until destruction is advanced. They are very resistant to insecticides, and can survive temperatures as low as —22°C. [—7·6°F.] and as high as 55°C. [131°F.].

Gassner (L.). **Die Grossbekämpfung von Vorratsschädlingen.** [Large Scale Control of Pests of Stored Food-stuffs.]—*Z. hyg. Zool. SchädlBekämpf.* **29** no. 6 pp. 176–178. Berlin, 1937..

For operations on a large scale against pests of food-stuffs in mills, warehouses and factories, the principal insecticides officially recognised in Germany are Zyklon B, Cartox, and hydrogen phosphide [*cf. R.A.E.* A **24** 476]. Hydrogen phosphide is particularly suitable for farm granaries as no sealing of the store-room is necessary.

Tesch (B.). **Die Entwesung von Getreide und Futtermitteln mit dem Cartox-Verfahren.** [The Disinfestation of Grain and Fodder by Means of the Cartox Process.]—*Z. hyg. Zool. SchädlBekämpf.* **29** no. 9 pp. 244–254, 3 figs. Berlin, 1937.

In view of the widespread use of Cartox for fumigating grain silos in Germany, a description of the process is given. Cartox is a mixture of 1 part ethylene oxide and 9 parts carbon dioxide, the use of which is subject to government regulations [*R.A.E.*, A **24** 476]. It may be supplied only to authorised persons and is delivered compressed

in steel cylinders of about 55 lb. capacity. Equipment provides for air to be extracted at the top of the silo, mixed with the fumigant released from the cylinder, and then blown into the bottom of the silo [**24** 623] so that it passes upwards through the grain. On an average 18 oz. of Cartox is required per ton of grain. A description is given of an instrument that measures the concentration of the fumigant mixture by comparing electrically its heat conductivity with that of ordinary air.

BREMER (H.). **Krankheiten und Schädlinge der Küchenzwiebel.** [Diseases and Pests of Onions.]—*NachrBl. SchädlBekämpf.* **12** no. 3 pp. 169–189, 15 figs., 32 refs. Leverkusen, August 1937. (With Summaries in English, French and Spanish.)

The most important pest of onions in Germany is *Hylemyia antiqua*, Mg., the bionomics and control of which are described [*R.A.E.*, A **18** 431, etc.]. Of leaf-miners that can cause serious damage if present in large numbers, the commonest is *Acrolepia assectella*, Zell. [*cf.* **20** 558]. *Thrips tabaci*, Lind., is found everywhere, but is not very injurious in Germany.

WADLEY (F. M.). **Observations on some Insects associated with Sugarcane in Puerto Rico.**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 103–114, 15 refs. Rio Piedras, P.R., July 1937.

The author discusses the results of surveys of the status and distribution of insects in and near fields of sugar-cane in Porto Rico, with special reference to those that might possibly transmit mosaic disease. The species noted particularly were *Sipha flava*, Forbes, *Saccharosydne saccharivora*, Westw., and mealybugs, mostly *Trionymus sacchari*, Ckll., which all occurred regularly on sugar-cane, and *Aphis maidis*, Fitch, *Carolinaia* (*Hysteroneura*) *setariae*, Thos., and *C. cyperi*, Ainslie, which were occasionally found on sugar-cane or were thought to transmit mosaic disease.

An intensive survey at the experiment station included examination of cane varieties, grasses and sedge. *Sipha flava* was abundant on sugar-cane, particularly the variety M. 505 and to a less degree P.R. 803, and only slightly less common on *Chaetochloa setosa*. It was attacked by predators, including *Cycloneda sanguinea*, L., and by a fungus (*Acrostalagmus*). *Saccharosydne saccharivora* was widely present on sugar-cane, but generally in small numbers. *T. sacchari* occurred on sugar-cane and *Sorghum*, a food-plant that is rare in Porto Rico. Wet weather appears to be unfavourable to it; it prefers old to young cane and was more numerous on P.O.J. 2878 than on other varieties. No insect enemies were observed. *A. maidis* was common throughout the year on *Sorghum* and tasselled maize, and a few individuals occurred on grasses and untasselled maize; scarcely any were taken on sugar-cane. Parasites reared from it included *Lysiphlebus testaceipes*, Cress., *Pachyneuron siphonophorae*, Ashm., and *Tetrastichus marylandensis*, Gir. Predators included Coccinellids and Syrphids. *C. setariae* occurred in moderate numbers on grasses, particularly, on *Eleusine indica*, and occasionally on cane along the south coast, but only very rarely elsewhere. Among the parasites reared were *L. testaceipes*, *P. siphonophorae* and *Aphidencyrtus*

aphidivorus, Mayr. *C. cyperi* only occurred on *Cyperus rotundus*, on which it was common.

The results of this survey were confirmed by those of a more extensive one carried out in September and October 1935 by taking 5 samples of 20 stalks from each of 34 sugar-cane fields selected at random in different localities. *Diatraea saccharalis*, F., was widespread and often injurious. *A. maidis* was taken on *Gynerium* and *Pennisetum* in addition to the plants already noticed, *Sipha flava* on maize and two grasses, and *C. setariae* on *Gynerium*. In a third survey carried out in March and April 1936, *D. saccharalis* was again found to be widespread, and chinch bugs (*Blissus leucopterus*, Say) were found on one stalk of cane ; other results were similar to those of the other two surveys.

Experiments on the transmission of mosaic disease have shown that *S. flava* is not a vector, but that both species of *Carolinaia* are able to transmit the disease. These Aphids, however, as well as mealybugs and *Saccharosydne saccharivora* are all about equally distributed throughout areas of slow and rapid spread of the disease, whereas a differential distribution in the two areas would be expected for the vectors. *A. maidis* has this type of distribution. In one experiment an Aphid not normally found on grasses, but taken on sugar-cane while feeding temporarily, proved to be capable of transmitting mosaic. Rapid spread of the disease on the island appears to be associated with diversified plant growth.

MADDEN (A. H.). **Notes on the Changa, or West Indian Mole Cricket, in Puerto Rico in 1935 and 1936.**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 115–119. Rio Piedras, P.R., July 1937.

Investigations were carried out in 1935 and 1936 on the damage caused to economic crops by *Scapteriscus vicinus*, Scudd., in Porto Rico ; it was apparently less than normal, probably because of a drought during part of this period. Sugar-cane was seldom severely injured and coffee only slightly, while in the highest infestation observed on tobacco, a favoured food-plant, only 10 per cent. of the plants were destroyed. In several fields of sweet maize and vegetables, 50–98 per cent. of the plants were killed, but as the area under these crops was small, the commercial loss was slight.

S. vicinus appears to be distributed round the coast and in the river valleys in sandy soils of light texture, which are those particularly suitable for vegetable crops. Any young plant may serve as food, although those with poisonous or acid sap are said to be avoided. The crickets also feed on decomposing matter in the soil, and will attack insects of their own or other species. Feeding at the stem and crown of the plant usually causes its death. Minor injuries are caused by feeding at the roots. The greatest damage normally occurred after heavy rains, which softened the soil, or after irrigation. Natural enemies of some importance include 11 species of birds, a list of which is given, and the giant toad, *Bufo marinus*. Satisfactory control is obtained by a bait of flour containing 3–10 per cent. Paris green broadcast after rain at the rate of 300 lb. per acre about a week before planting, or applied at the rate of 150 lb. per acre in shallow trenches round each plant. Tests indicated that the substitution of wheat bran for flour increased the efficiency of the bait. A mixture of 8 oz. pyrethrum powder in 2 U.S. gals. water kills crickets immediately

below the surface when poured directly on to the soil, but this method is costly. A strong soap solution used similarly drives the crickets from their burrows, and they may then be collected and killed.

Dozier (H. L.). **Descriptions of miscellaneous Chalcidoid Parasites from Puerto Rico (Hymenoptera).**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 121–135. Rio Piedras, P.R., July 1937.

Descriptions are given of 13 new species of Chalcidoid parasites from Porto Rico, including the Encyrtid, *Leptomastidea antillicola* from *Ferrisiana* (*Pseudococcus*) *virgata*, Ckll., on foliage of *Inga inga*; the Aphelinid, *Encarsia nigricephala* from *Bemisia* sp. on *Euphorbia hypericifolia*; and the Eulophid, *Tetrastichus tatei* from *Gynaikothrips uzeli*, Zimm., on *Ficus nitida*. Three new Aphelinids described from other localities are *Hispaniella howardi* from *Parlatoria pergandei camelliae*, Comst., in Haiti; *Prospaltella pulchella*, which was reared from a shipment of apple twigs infested with the woolly apple aphis [*Eriosoma lanigerum*, Hsm.] imported from Delaware into Haiti in connection with the attempted introduction of *Aphelinus mali*, Hald., and is thought to be a parasite of some Coccid on apple; and *P. elongella* from *Lepidosaphes gloveri*, Pack., on *Euonymus* in New Orleans. The last species appears to be an important parasite of *L. gloveri* and is probably responsible for the low infestation of *Citrus* by this Coccid round the Gulf Coast, where *L. beckii*, Newm., which is not checked by natural enemies, is the most serious pest of *Citrus*. Rearing records are also given of 4 little known Encyrtids, including *Homalopoda cristata*, How., from *Ceroplastes giganteus*, Dozier, on *Ficus rubricosta* in Haiti; and *Pseudhomalopoda prima*, Gir., from *Chrysomphalus ficus*, Ashm. (*aonidum*, auct.) in Haiti and Santo Domingo, from foliage of *Terminalia catappa* infested with *Aspidiotus destructor*, Sign., and *Saissetia oleae*, Bern., in Haiti, and from lemon foliage infested by *C. ficus* and *L. beckii* in Porto Rico.

Fife (L. C.). **Damage to Sea Island Cotton by the West Indian Blister Mite (*Eriophyes gossypii* Banks) in Puerto Rico.**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 169–177, 3 figs., 4 refs. Rio Piedras, P.R., July 1937.

An account is given of the damage caused to cotton by *Eriophyes gossypii*, Banks, in Porto Rico, where it is a major pest of this crop. *E. gossypii* has caused serious injury in India [*R.A.E.*, A **17** 569], as well as in the West Indies, and it also occurs in Florida [**22** 637]. During 1936, infestation was heavy in the north and light in the south of Porto Rico. The most noticeable injuries to heavily infested plants are crumpled leaves, distorted growth and lack of fruiting branches. Small leaves develop later along the main stem where fruiting branches usually form. There appeared to be no abnormal shedding of the squares or young bolls.

To determine the extent of injury to cotton, two counts were made, on 20th April and 6th May, of the number of fruiting branches, squares, bolls and blooms of plants selected at random from a three-acre field, and the heights of the plants were measured. The plants were classified according to the degree of infestation. There were fewer squares, fruiting branches, bolls and blooms on heavily infested than on lightly infested or uninfested plants, the average differences in the numbers

of each part of the plant descending in that order on both counts. In another test, a plot containing 100 plants was selected in each of 2 adjacent fields and the numbers of fruiting branches, squares, and bolls, and the heights of the plants in each of the plots were recorded twice monthly from 15th April to 10th July. Infestation was originally heavy on one plot and light on the other, but it increased on the latter plot until by 10th July it was heavy. All factors except intensity of infestation seemed to be uniform on the two plots. The difference in number of fruiting branches per plant on the two plots increased progressively at each examination, and ranged from 1·69 to 5·24. The average difference in the number of bolls produced by lightly and heavily infested plants was 3·61 and ranged from 0·08 in mid-April to 7·31 in July. Damage was not accurately measured by these means as the lightly infested plot suffered considerable injury. Observations in Porto Rico indicate that there is no hibernation period ; mites continue to develop throughout the year on green cotton that has not been destroyed. A thorough cleaning of the old fields and a strict enforcement of a close season when no green cotton is present would probably give control.

FIFE (L. C.). **Status of the Pink Bollworm in Puerto Rico during 1935–36.**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 233–235. Rio Piedras, P.R., July 1937.

Partly owing to the damage caused by *Platyedra* (*Pectinophora*) *gossypiella*, Saund., the production of sea island cotton in Porto Rico has been largely discontinued, the area planted decreasing from 20,000 acres in 1931 [*cf. R.A.E.*, A **20** 401] to 100 acres of seed cotton in 1934. In 1934–35, however, preparatory to the re-development of commercial cotton-growing, wild cotton, which is the most important alternative food-plant of *P. gossypiella*, was almost eradicated on the island. In 1935-36 about 2,000 acres of cotton were planted. *P. gossypiella* occurred throughout the commercial cotton-growing region along the north coast, and in parts of that along the south and south-west coast. Wild cotton on the east and south-east coasts was also infested ; it is suggested that the infestation in this case was probably due to moths brought by air currents from adjacent islands on the east. *P. gossypiella* was not found on cotton in the interior, but there both commercial and wild cotton plants are rare. In 1935, infestation occurred late in the season and was most severe in December, when boll infestation per field averaged 30·2 per cent. and ranged from 3 to 95 per cent. In 1936, infestation was unusually heavy. In the cotton-growing regions of the north coast, the boll infestation per field averaged 24·3 per cent. and ranged up to 100 per cent. according to locality. At least 30 per cent. of the crop was destroyed in the entire cotton-growing area, and in one district the loss reached 50 per cent. The probable reasons for such high infestations included the use of infested seed, the short close season between the crops of 1935 and 1936, which permitted the building up of the population and the increase in numbers of long-cycle larvae, and inadequate clearing of the fields after harvest. At least 65 per cent. of the larvae in the open cotton bolls were of the long-cycle type, and the maximum duration of this stage was 172 days, so that many larvae were present to attack the next crop. During the close season, a few larvae fed on the seed

capsules of *Montezuma speciosissima* and *Thespesia populnea* [*cf. loc. cit.*]. In the south, infestation was low in 1936, ranging from 0 to 37 per cent. and averaging 12·9 per cent., although in one field it reached 86 per cent. The climate of Porto Rico favours the development of *P. gossypiella* throughout the year.

DOHANIAN (S. M.). **The Introduction of Parasites of the Sugarcane Borer into Puerto Rico.**—*J. Agric. Univ. Puerto Rico* **21** no. 2 pp. 237–241. Rio Piedras, P.R., July 1937. **The Importation of Coccinellid Enemies of Diaspine Scales into Puerto Rico.**—*T.c.* pp. 243–247, 2 refs.

These papers deal with the collection abroad and introduction into Porto Rico of parasites against *Diatraea saccharalis*, F., on sugar-cane, and Coccinellid predators against *Aspidiotus destructor*, Sign., on coconut, and the information in them is substantially the same as that contained in one already noticed [*R.A.E.*, A **25** 616].

LEACH (J. G.), ORR (L. W.) & CHRISTENSEN (C.). **Further Studies on the Inter-relationship of Insects and Fungi in the Deterioration of felled Norway Pine Logs.**—*J. agric. Res.* **55** no. 2 pp. 129–140, 8 figs., 2 refs. Washington, D.C., 15th July 1937.

The following is from the authors' summary: As a part of a study in Minnesota of the interrelation of insects and fungi in the deterioration of logs of Norway pine (*Pinus resinosa*) [*cf. R.A.E.*, A **23** 1], the changes in logs during the second and third years after felling were studied. During this period, in fully exposed logs, the entire sapwood and much of the heartwood were decayed, *Peniophora gigantea* being primarily responsible. There was no evidence that this fungus was dependent upon insects for dissemination or ingress. It is apparently disseminated readily by wind and may enter through cracks in the bark or holes made by insects. The decay develops very rapidly in the sapwood, but in the heartwood it spreads rather slowly longitudinally and very slowly radially and tangentially. Several different species of insects were found in the logs, the most prevalent wood-boring beetles being the Lamiids, *Monochamus scutellatus*, Say, and *M. notatus*, Dru., and the Buprestids, *Chrysobothris dentipes*, Germ., and *Chalcophora virginiensis*, Dru. There was a fair degree of correlation between the number of *Monochamus* beetles in the logs and the amount of heartwood decayed. The larvae of these insects appear to hasten the decay by facilitating the radial and tangential invasion of the heartwood by *P. gigantea*. The open larval tunnels favour the spread of the decay. The Buprestids have little influence on the rate of decay of the heartwood, probably because their tunnels are closed, and the influence of other species that inhabit the bark and outer layers of sapwood also appears to be slight.

STRAND (A. L.). **Montana Insect Pests for 1935 and 1936. The twenty-sixth Report of the State Entomologist of Montana.**—*Bull. Mont. agric. Exp. Sta.* no. 333, 39 pp., 7 figs. Bozeman, Mont., January 1937. [Recd. September 1937.]

In 1935, infestation by grasshoppers was severe along the Yellowstone river in Montana, where it had not been expected [*cf. R.A.E.*, A **23** 656], but thousands of acres of irrigated crops were saved by

campaigns begun in July. The 1936 campaign, in which 36 counties were engaged, also largely on irrigated crops, was one of the most successful ever carried out in the State. Damage to range forage grasses, which increased considerably during the two years, was caused by several species, of which the chief were *Aulocara elliotti*, Thomas, and *Melanoplus mexicanus*, Sauss. The control of these infestations, either between outbreaks or when they are beginning or in progress, is discussed, and a combination of the two methods is thought to be desirable. During the years 1934-36, the total loss of range and cultivated crops was estimated at over £2,300,000 and the saving of cultivated crops effected by control measures at over £2,000,000. A little more than 1,595 tons of bait was used in 1935 and 3,063 tons in 1936. It was estimated that 7,759 tons would be required in 1937. Damage valued at over £68,000 was done to cultivated crops in 1936 by the Mormon cricket [*Anabrus simplex*, Hald.] in addition to damage to range. Control was started too late. As the young nymphs appear in late March or early April and are much more gregarious then than later, work in early spring can be concentrated on about 10 per cent. of the area otherwise involved.

In 12 counties in which less than 3 ins. of rain fell in May and June in two consecutive seasons, an increase in *Porosagrotis* (*Agrotis*) *orthogonia*, Morr., is expected for 1937. In 1936, it caused more severe damage to cereals in some of these counties than for many years past. Say's plant bug [*Chlorochroa sayi*, Stål] was not so noticeable in 1936 as in the four preceding years [**24** 161], on account of the reduction in the wheat crop by drought and grasshoppers. Oviposition was almost continuous from May to October. The peak of egg-laying by first-generation adults was in July. The average number of eggs in a mass was 30, and the incubation period 4–7 days. Of all the eggs collected, 10 per cent. were parasitised by *Telenomus ashmeadi*, Morrill ; 11·7 per cent. of the adults were parasitised by the Tachinids, *Gymnosoma fuliginosum*, R.-D., *Cylindromyia armata*, Aldr., and *Senotainia vigilans*, Allen, of which the last two have not previously been recorded from this host. *Collops bipunctatus*, Say, preyed on the eggs in the field. In 1936, *Loxostege sticticalis*, L., appeared in great numbers for the first time since 1932 [**21** 229] ; sugar-beet in some fields was infested when only 2–3 ins. high and completely destroyed. In sections of two counties, about 90 per cent. of the females of the overwintered generation were sterile, as were many of the first-generation females throughout the greater part of the State. *Epicauta maculata*, Say, and other blister beetles, the larvae of which feed on grasshopper eggs, caused serious losses of beet, potatoes and ornamental plants in 1935 and 1936. The most abundant pest in the irrigated section in 1936 was the false chinch bug [*Nysius ericae*, Schill.], which often caused the failure of potato crops, though maize recovered from what seemed at first to be rather serious injury.

Of sour cherries unsprayed for two seasons, 40 per cent. were infested with *Rhagoletis fausta*, O. S., in 1935, and the maggots were found in sweet cherries near sour cherry trees, which should be used as a trap crop. The population was low in 1936, as in 1934. On apple, a calyx spray and 2 cover sprays of 3 lb. lead arsenate, 1 lb. spreader and 100 U.S. gals. water, carefully timed, gave satisfactory control of *Cydia* (*Carpocapsa*) *pomonella*, L., of which there is one brood annually, and lime-sulphur (1 : 8), applied as a dormant spray, gave the best control of *Lepidsosaphes ulmi*, L. Against *Otiorrhynchus*

(*Brachyrrhinus*) *ovatus*, L., the major pest of strawberries in the west, ploughing in the crop after two seasons and growing a cover crop for one year aids control, but the best results are obtained with a bait of 10 lb. arsenic, 45 lb. bran, 45 lb. dried apple, and water to make a crumbly mass, applied at the rate of 50 lb. per acre when the overwintered weevils appear and again in late June or early July. *Ancylis comptana*, Froel., became injurious in some areas, but was controlled with two applications of a spray of 1 lb. lead arsenate in 50 U.S. gals. water applied before the leaves rolled, or by contact sprays of oil and nicotine or nicotine and soap. Lead arsenate at the same strength controls heavy infestations of *Monophadnus* (*Monophadnoides*) *rubi*, Harr., on raspberry. *Malacosoma disstria*, Hb., completely defoliated hundreds of poplar trees in 1936, though injury was not permanent.

O'Kane (W. C.), Glover (L. C.) & Westgate (W. A.). **The Performance of certain Contact Agents on various Plant Surfaces. Studies of Contact Insecticides. XII.**—*Tech. Bull. N. H. agric. Exp. Sta.* no. 68, 22 pp., 20 figs., 5 refs. Durham, N.H., May 1937.

The following is the authors' summary: This bulletin summarises the results of a series of studies in which the contact angles (at 15 seconds) of several contact agents on a number of plant surfaces were measured. The contact agents included sodium oleate, saponin, triethanolamine oleate, potassium coconut oil soap, Gardinol [a material stated to be a mixture of sodium salts of sulphated alcohols obtained from coconut or palm kernel oil and in which the principal salt is sodium lauryl sulphate], calcium caseinate, and monoamylamine oleate. Nine species of plant leaf and seven species of plant stem were used as surfaces. Paraffin-coated glass slides and two species of insects [*Aphis rumicis*, L., and *Tenebrio molitor*, L.] were used for comparison. Surface tensions were measured. The materials studied gave definite variations in contact angles on the various plant surfaces. Calcium caseinate and saponin, with few exceptions, gave high angles. Gardinol and potassium coconut oil soap exhibited low angles on some plant surfaces and high angles on others. Sodium oleate, triethanolamine oleate, and monoamylamine oleate exhibited low angles on nearly all of the plant surfaces used. The exact nature of a leaf surface or stem surface is of evident importance in the performance of a contact agent.

Cottier (W.) & Taylor (G. G.). **The Tomato Mite** (*Phyllocoptes* **sp.**).—*N. Z. J. Agric.* **55** no. 1 pp. 28–31, 2 figs., 2 refs. Wellington [N. Z.], July 1937.

In October 1936, glasshouse tomatos in the Auckland District, New Zealand, were infested by a mite that was identified by A. M. Massee as *Phyllocoptes lycopersici*, Tryon; he pointed out, however, that this was a *nomen nudum*. The mite is very briefly described in this paper, but is referred to as *Phyllocoptes* sp. In a survey carried out in the summer of 1936–37, most of the glasshouse tomato crops in the district were clean, but isolated cases of infestation occurred, and in some of these over 50 per cent. of the plants were attacked. It is thought that serious infestation first occurred in 1935. It has not been reported

from any other centres of tomato-growing or from any field crops. The types of damage are described [*cf. R.A.E.*, A **24** 211]. It is thought that the life-cycle is short, as small initial infestations rapidly become severe. Where two crops are grown in rapid succession each year, the second is likely to be infested, although houses have sometimes been replanted within 3 weeks of the removal of an infested crop without any subsequent attack by the mite. It is probable that mites can overwinter in unheated houses, as live mites were found in spring on the old plants of an abandoned crop that had been heavily infested in the previous autumn. The mites may be carried on clothing, and clean houses may become infested by the introduction of seedlings from infested nurseries.

Complete control was obtained by fumigation with nicotine sulphate, 25 cc. per 1,000 cu. ft. Where this is impracticable, a spray of 1 pint nicotine sulphate in 100 gals. water with 2–3 lb. soft soap should be applied. Treatment should be given as soon as the mites are noticed, and is advisable as a precautionary measure as soon as a new crop is established. Where two crops are grown each year, the interval between the removal of an infested crop and the subsequent planting should be as long as possible. All old plants should be removed and the soil in empty houses thoroughly cultivated.

TAYLOR (G. G.). **Application of Orchard Sprays. IV. Spray Coverage.** —*N. Z. J. Agric.* **55** no. 1 pp. 32–41, 5 figs. Wellington [N. Z.], July 1937.

In this paper, which is one of a series on orchard spraying in New Zealand [*cf. R.A.E.*, A **25** 677], an account is given of experiments showing the effect on spray coverage of increases in volume application or the time of spraying. With sprays of lead arsenate (1½ lb. in 100 gals. water) and 1 per cent. summer oil against codling moth [*Cydia pomonella*, L.] and red mite [*Paratetranychus pilosus*, C. & F.], respectively, both on apple, control increased with volume delivery. It is concluded that, although wastage of spray could be reduced to a minimum by maintaining a low rate of delivery and spending a sufficient time in spraying, it is more economical to reduce spraying time and to overcompensate with volume delivery in order to obtain maximum coverage.

RUNGS (C.). **Un nouvel ennemi du chêne-liège** (*Quercus suber*) **au Maroc.**—*Bull. Soc. Sci. nat. Maroc* **17** pp. 13–14. Rabat, August 1937.

In 1936, portions of trunk and branches of cork oak (*Quercus ilex* var. *suber*) from north-western Morocco, infected with *Hypoxylon sertatum*, but otherwise healthy, yielded, in addition to considerable numbers of *Agrilus hastulifer*, Ratz., the larvae of which infest the bark, adults of *Xylotrechus antilope*, Schönh. This Cerambycid has not previously been recorded from Morocco. The beetles paired in the hottest part of the day on the side of the trees exposed to the sun, and females began to oviposit 6–8 days later. The eggs were laid, 3–4 at a time, in cracks or rough places in the bark. Damage to infested trees was considerable, as the mines, the average width of which was 3 mm., penetrated the heartwood. They are blocked with frass. Pupation takes place in the young wood. Certain parasitic fungi appear to follow the mines.

Imms (A. D.). **Recent Advances in Entomology. 2nd Edn.**—Demy 8vo, x + 431 pp., 94 figs. London, J. & A. Churchill Ltd, 1937. Price 15*s*.

This is a revised edition of a book first published in 1931 [*R.A.E.*, A **18** 690]. The general arrangement is unchanged, but certain chapters are modified and supplemented with new data. Subjects of interest to economic entomologists on which the information has been revised, re-written or extended include insect responses to light, fatal low temperatures, humidity, climate in relation to distribution, symbiotic micro-organisms, biological races, locust phases, and the control of noxious weeds by insects. A new section on the influence of air currents on dispersal of insects is added.

Murphy (P. A.) & Loughnane (J. B.). **A ten Years' Experiment on the Spread of Leaf Roll in the Field.**—*Sci. Proc. R. Dublin Soc.* N.S. **21** no. 50 pp. 567–579, 3 figs., 7 refs. Dublin, August 1937.

The following is mainly the authors' summary : In a field experiment in County Dublin conducted under the same conditions for ten years, the extent of the spread of leaf-roll of potato was determined in relation to weather and Aphid population. The years fell into 3 classes, the percentage of infection within 10½ ft. of the sources of disease being 75 per cent. or less in the first, 50 per cent. or less in the second and 15 per cent. or less in the third. The minimum spread of infection extended to the third plant along the drill, and to the first to third drill, and the maximum exceeded the fourteenth plant and fifth drill and was not determined. In an average year, no plant separated from the sources by less than 80 ins. along the drills and 50 ins. across them is likely to escape infection. Under the same conditions, the chances of infection are slight in plants separated by more than 21 ft. along the drills and 10½ ft. across them. The disease regularly spread somewhat more to the north than to the south, and slightly more to the east than to the west, probably on account of the prevailing south-west winds. Aphids were notably most abundant in the years of greatest spread, 1926 and 1929, and least so in the year of minimum spread, 1931, and were probably in similar proportion throughout. Alates of *Myzus persicae*, Sulz., usually appeared about 15th May, soon after the plants came up. *Macrosiphum solanifolii*, Ashm. (*gei*, auct.) always came later and left sooner. It is thought that most of the leaf-roll infection took place during 6 weeks from the end of May to early July. The resulting primary leaf-roll appeared over about 9 weeks, from the end of June, some 45 days after the Aphids first arrived or 20 days after they become numerous enough to be noticed on ordinary close inspection, until the end of August, the incubation period lengthening from about 37 days at first to 40–60 days later. In late seasons, July or later becomes the principal infection period, and this is probably the rule in northern districts. In the 3 years of least spread, June was excessively wet. The most important effect of the weather was to restrict the increase of Aphids during the critical period, and this was reinforced by very dry weather in July, which hardened the plants, or by a continuation of the wet weather. The conditions producing maximum infection were comparatively normal rainfall and temperature in June, permitting rapid growth of the plants and simultaneous increase of the Aphids. The

years of moderate infection were marked by low rainfall and high temperature in June, these conditions being favourable for the Aphids (apart from parasites), but tending to ripen the plants prematurely. *Myzus persicae* hibernated each year in an active condition on cabbages in a neighbouring garden and no doubt reached the potatoes from this source. The general absence of leaf-roll from farms in eastern Ireland, where the conditions correspond to those of the experimental field, must be due to the scarcity of the winter food-plants of *M. persicae* near potato fields, as weather conditions in June are so often favourable to infection.

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